DR. RAM MANOHAR LOHIA AVADH UNIVERSITY, AYODHYA

Structure of Syllabus for the

Program: M.Sc., Subject: PHYSICS (ELECTRONICS)

Structure of Syllabus Developed by			
Name of BoS Convener/ BoS Member	**Designation**	**Department**	**College/ University**
Prof. C.K. Mishra	Dean	Faculty of Science	Dr. R.M.L. Avadh University, Ayodhya
Prof. Anupam Srivastava	Head & Convenor	Physics & Electronics	Dr. R.M.L. Avadh University, Ayodhya
Prof. R.K.Tiwari	Professor	Physics & Electronics	Dr. R.M.L. Avadh University, Ayodhya
Prof. S.N.Shukla	Professor	Physics & Electronics	Dr. R.M.L. Avadh University, Ayodhya
Prof. K.K.Verma	Professor	Physics & Electronics	Dr. R.M.L. Avadh University, Ayodhya
Prof. G.R.Mishra	Professor	Physics & Electronics	Dr. R.M.L. Avadh University, Ayodhya
Dr. Geetika Srivastava	Associate Professor	Physics & Electronics	Dr. R.M.L. Avadh University, Ayodhya
Dr. Anil Kumar	Assistant Professor	Physics & Electronics	Dr. R.M.L. Avadh University, Ayodhya
Prof. D.K.Dwivedi	Professor	Physics & Material Science	MMM University of Technology, Gorakhpur
Prof. R.K.Singh	Professor	Physics	BHU, Varansi
Prof. Umesh Yadav	Professor	Physics	DDU Gorakhpur University Gorakhpur
Prof. Manish Mishra	Professor	Department of Electronics	DDU Gorakhpur University Gorakhpur
Dr.U.N.Tripathi	Professor	Department of Computer Science	DDU Gorakhpur University Gorakhpur

Course Code		**Course Title**	**Credits**	**T/P**	**Evaluation**	
					CIE	**ETE**
A	B	C	D	E	F	G
SEMESTER I (YEAR I)						
B220701T	CORE	Mathematical Physics	4	T	25	75
B220702T	CORE	Classical Mechanics	4	T	25	75
B220703T	CORE	Semiconductor Devices and Circuits	4	T	25	75
B220704T	CORE	Digital System Design	4	T	25	75
B220705T	FIRST ELECTIVE (Subject Elective) (Select any one)	Electronic Measurement and Instrumentation	4	T	25	75
B220706T		Programming in C	4	T	25	75

17/12/2022

B220707P	SECOND ELECTIVE (Subject Elective) (Select any one)	Physics Laboratory Course -I (A)	5	P	50	50
B220708P		Physics Laboratory Course -I (B)	5	P	50	50
SEMESTER II (YEAR I)						
B220801T	CORE	Electrodynamics	5	T	25	75
B220802T	CORE	Quantum Mechanics	5	T	25	75
B220803T	CORE	Microprocessor and Microcontrollers	5	T	25	75
B220804T	THIRD ELECTIVE (Generic Elective) (Select any one)	Introduction to MATLAB Programming	5	T	25	75
B220805T		Computer Oriented Numerical Methods	5	T	25	75
B220806P	FOURTH ELECTIVE (Select any one)	Physics Laboratory Course -II (A)	5	P	50	50
B220807P		Physics Laboratory Course -II (B)	5	P	50	50
SEMESTER III (YEAR II)						
B220901T	CORE	Thermodynamics and Statistical Mechanics	4	T	25	75
B220902T	CORE	Advanced Quantum Mechanics	4	T	25	75
B220903T	CORE	Communication Theory and Systems	4	T	25	75
B220904T	CORE	Condensed Matter Physics	4	T	25	75
B220905T	FIFTH ELECTIVE (Subject Elective) (Select any one)	Analog Integrated Circuits	4	T	25	75
B220906T		Materials: Introduction, Synthesis and Processing	4	T	25	75
B220907P	SIXTH ELECTIVE (Subject Elective) (Select any one)	Physics Laboratory Course -III (A)	5	P	50	50
B220908P		Physics Laboratory Course -III (B)	5	P	50	50
SEMESTER IV (YEAR II)						
B221001T	CORE	Atomic and Molecular Physics	5	T	25	75
B221002T	CORE	Nuclear and Particle Physics	5	T	25	75
B221003T	SEVENTH ELECTIVE (Subject Elective) (Select any one)	VLSI Design and Technology	5	T	25	75
B221004T		Optoelectronics and Optical Communication	5	T	25	75
B221005P	RESEARCH PROJECT/ DISSERTATION	Major Research Project/ Dissertation	10	P	50	50
Total Credits	100					

Program Outcomes (POs):
• The program has been designed in such a way that the students acquire strong theoretical and practical knowledge in various domains of Physics. • The programme includes details of Mathematical Physics, Classical Mechanics, Quantum Mechanics, Statistical Mechanics, Molecular and Atomic Physics, Nuclear and Particle Physics, Electronic Devices, Digital System Design, Microprocessor, Communication System, Electrodynamics and VLSI Design and Technology etc to provide in depth knowledge of Physics and Electronics so that they can contribute in the society in their respective research area and become entrepreneur. • The practical courses have been designed to equip the students with the laboratory skills in Physics & Electronics. Students will able to hardware design, application of various devices and circuits for system design and verification. • The program will offer students with the knowledge and skill base that would enable them to undertake advanced studies in field of Physics and related areas or in multidisciplinary areas that involves Physics. • The students will get exposure of wide range of careers that includes, Particle Physics, Atomic Physics, VLSI design, Communication Engineering. • The students will gain domain knowledge for successful career in academia, industry and research. • Moreover, students will learn values for lifelong learning to meet the ever-evolving professional demands by developing ethical, inter personal and team skills.

Semester wise Paper Titles with Details					
Year	**Semester**	**Paper**	**Paper Title**	**Prerequisite for Paper**	**Elective for Major Subjects**
Master in Physics (Electronics)					
First	SEM-I	Theory Paper – I (Core)	Mathematical Physics	B.Sc. (Physics, Chemistry, Mathematics, Electronics, Computer Science, Computer Application, Statistics)	M.Sc (Physics/ Computer Science/Mathematics/ Statistics)
		Theory Paper –II (Core)	Classical Mechanics	B.Sc. (Physics, Chemistry, Mathematics, Electronics, Computer Science, Computer Application, Statistics)	M.Sc (Electronics/ Mathematics/)
		Theory Paper – III (Core)	Semiconductor Devices and Circuits	B.Sc. (Physics, Chemistry, Mathematics, Electronics, Computer Science, Computer Application, Statistics)	M.Sc (Electronics/ Mathematics/ Computer Science)
		Theory Paper – IV (Core)	Digital System Design	B.Sc. (Physics, Chemistry, Mathematics, Electronics, Computer Science, Computer Application, Statistics)	M.Sc (Electronics/ Mathematics/ Computer Science)

		Theory Paper – V First Elective (Subject Elective-Select any one)	Electronic Measurement and Instrumentation	B.Sc. (Physics, Chemistry, Mathematics, Electronics, Computer Science, Computer Application, Statistics)	M.Sc (Electronics/ Mathematics/ Computer Science)
			Programming in C	B.Sc. (Physics, Chemistry, Mathematics, Electronics, Computer Science, Computer Application, Statistics)	M.Sc (Electronics/ Mathematics/ Computer Science)
		Practical Second Elective (Subject Elective-Select any one)	Physics Laboratory Course -I (A)	B.Sc. (Physics, Chemistry, Mathematics, Electronics, Computer Science, Computer Application, Statistics)	
			Physics Laboratory Course -I (A)	B.Sc. (Physics, Chemistry, Mathematics, Electronics, Computer Science, Computer Application, Statistics)	
	SEM-II	Theory Paper – I (Core)	Electrodynamics	B.Sc. (Physics, Chemistry, Mathematics, Electronics, Computer Science, Computer Application, Statistics)	M.Sc (Electronics)
		Theory Paper –II (Core)	Quantum Mechanics	B.Sc. (Physics, Chemistry, Mathematics, Electronics, Computer Science, Computer Application, Statistics)	
		Theory Paper – III (Core)	Microprocessor and Microcontrollers	B.Sc. (Physics, Chemistry, Mathematics, Electronics, Computer Science, Computer Application, Statistics)	M.Sc (Electronics/ Mathematics/ Computer Science)
		Third Elective (Generic Elective-Select any one)	Introduction to MATLAB Programming	B.Sc. (Physics, Chemistry, Mathematics, Electronics, Computer Science, Computer Application, Statistics)	M.Sc (Electronics/ Mathematics/ Computer Science)
			Computer Oriented Numerical Methods	B.Sc. (Physics, Chemistry, Mathematics, Electronics, Computer Science,	M.Sc (Electronics/ Mathematics/

				Computer Application, Statistics)	Computer Science)
		Forth Elective (Select any one)	Physics Laboratory Course -II (A)	B.Sc. (Physics, Chemistry, Mathematics, Electronics, Computer Science, Computer Application, Statistics)	
			Physics Laboratory Course -II (B)	B.Sc. (Physics, Chemistry, Mathematics, Electronics, Computer Science, Computer Application, Statistics)	
Second	SEM-III	Theory Paper - I	Thermodynamics and Statistical Mechanics	B.Sc. (Physics, Chemistry, Mathematics, Electronics, Computer Science, Computer Application, Statistics)	M.Sc (Electronics)
		Theory Paper - II	Advanced Quantum Mechanics	B.Sc. (Physics, Chemistry, Mathematics, Electronics, Computer Science, Computer Application, Statistics)	M.Sc (Electronics)
		Theory Paper – III	Communication Theory and Systems	B.Sc. (Physics, Chemistry, Mathematics, Electronics, Computer Science, Computer Application, Statistics)	M.Sc (Electronics)
		Theory Paper - IV	Condensed Matter Physics	B.Sc. (Physics, Chemistry, Mathematics, Electronics, Computer Science, Computer Application, Statistics)	M.Sc (Electronics/ Mathematics/ Computer Science)
		Fifth Elective (Subject Elective- Select any one)	Analog Integrated Circuits	B.Sc. (Physics, Chemistry, Mathematics, Electronics, Computer Science, Computer Application, Statistics)	M.Sc (Electronics/ Computer Science)
			Materials: Introduction, Synthesis and Processing	B.Sc. (Physics, Chemistry, Mathematics, Electronics, Computer Science, Computer Application, Statistics)	M.Sc (Electronics/ Computer Science)
		Sixth Elective (Subject Elective-	Physics Laboratory Course -III (A)	B.Sc. (Physics, Chemistry, Mathematics, Electronics, Computer Science, Computer Application, Statistics)	

		Select any one)	Physics Laboratory Course -III (B)	B.Sc. (Physics, Chemistry, Mathematics, Electronics, Computer Science, Computer Application, Statistics)	
	SEM-IV	Theory Paper - I	Atomic and Molecular Physics	B.Sc. (Physics, Chemistry, Mathematics, Electronics, Computer Science, Computer Application, Statistics)	
		Theory Paper - II	Nuclear and Particle Physics	B.Sc. (Physics, Chemistry, Mathematics, Electronics, Computer Science, Computer Application, Statistics)	
		Seventh Elective (Subject Elective- Select any one)	VLSI Design and Technology	B.Sc. (Physics, Chemistry, Mathematics, Electronics, Computer Science, Computer Application, Statistics)	M.Sc (Electronics)
			Optoelectronics and Optical Communication	B.Sc. (Physics, Chemistry, Mathematics, Electronics, Computer Science, Computer Application, Statistics)	M.Sc (Physics/ Computer Science)
		Research Project/Dissertation	Major Research Project/Dissertation		

Program/Class: Master of Science in Physics (Electronics)	Year: First	Semester: I
Subject: Physics (Electronics)		
Course Code: B220701T	Course Title: Mathematical Physics	

Course Objectives:

The objective of the course is to provide knowledge of various Mathematical Techniques to students of M.Sc Physics. This Course includes good insight of important concepts of Fourier series, Fourier transform Laplace Transform and their application in Physics. This is also foundation course for advanced courses in Physics.

Course outcomes:

At the end of this course, students will be

1. Able to understand the application of mathematics in solving the problems related to Physical Sciences.
2. Use of Residue theorem and Integral formula to evaluate various integrals.
3. Use of Laplace Transform to solve the differential equation.
4. Able to inculcate the habit of mathematical thinking and lifelong learning.

Credits: 4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks: **40**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 3-1-0

Unit	Topics	No. of Lectures
I	Function of complex variable, limit, continuity and differentiability of function of complex variables, Analytic function, Cauchy-Riemann conditions, Cauchys integral theorem, Cauchy's Integral formula, Taylor's and Laurent's series, singular points, residues, Cauchy's residue theorem, evaluation of integrals of single valued function.	15
II	Fourier series, Dirichlets conditions, Fourier series of periodic functions, Half-wave expansions, Fourier series in exponential form, Fourier integral theorem, Fourier transform and its properties, Application of Fourier Transform	15
III	Laplace Transform and its existence, Laplace Transform of standard functions, properties of Laplace Transform, Convolution theorem, shifting theorem, Laplace transforms of derivatives and integral of a function, Inverse Laplace transform, application of Laplace transform in solving differential equations.	15
IV	Matrices: Orthogonal, Unitary and Hermitian Matrices, Inverse of a matrix, Eigen values & Eigen vectors	15

Suggested Readings:

1. Arfken and H. J. Weber Mathematical Methods for Physicists, Academic Press, San Diego
2. A.W. Joshi, Matrices and Tensors in Physics, Wiley Eastern, New Delhi.
3. P. K. Chatopadhyay, Mathematical Physics, Wiley Eastern, New Delhi
4. C. Harper, Introduction to Mathematical Physics, Prentice Hall of India, New Delhi.
5. M. L. Boas, Mathematical Methods in the Physical Sciences, Wiley, New York.
6. L. Pipes & L. R. Horwell, Applied Mathematics for Engineers and Physicists
7. Mary L. Boas, Mathematics for Physicist

8. B. S. Rajput, Mathematical Physics
9. A. K. Ghatak, I. C. Goyal, Mathematical Methods for Physicists
10. A.W. Joshi, Elements of Group Theory, New Age Int.
11. E. Kreyszig Advanced Engineering Mathematics, Wiley Student Edition
12. Sadri Hussain, Mathematical methods for standard of Physics and related fields-, Springer
13. E. C. Tichmersh, Complex Analysis.

This course can be opted as an elective by the students of following subjects

Physics/Computer Science/ Mathematics/Statistics

Suggested Continuous Evaluation Methods:

Total Marks: 25

Internal Test: 10 Marks

Home Assignment/Presentation /Project / Research Orientation/ Term Papers/Seminar: 10 Marks

Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have had the subject Physics/Electronics/Computer Science/ Mathematics/Statistics/Computer Application in B.Sc.

Suggested equivalent online courses:

1. MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning (NPTEL), https://www.youtube.com/user/nptelhrd
3. Uttar Pradesh Higher Education Digital Library, http://heecontent.upsdc.gov.in/SearchContent.aspx
8. SwayamPrabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program

Further Suggestions: .....

Program/Class: Master of Science in Physics (Electronics)	Year: First	Semester: I
Subject: Physics (Electronics)		
Course Code: B220702T	Course Title: Classical Mechanics	

Course Objectives:

The objective is to emphasize the understanding of Classical Mechanics using Lagrangian and Hamiltonian Approach. To realize the Coriolis force and understand the rigid body problems.

Course outcomes:

After completion of this course, a student will be able to:
CO1: Students will be able to understand the Lagrangain approach to solve the problems.
CO2: They will learn different approaches used in Classical Mechanics and their physical significance.
CO3: They will learn use and importance of Canonical transformations.
CO4: They will be able angular velocity, angular momentum and their applications.

Credits:4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 3-1-0

Unit	Topics	No. of Lectures
I	Mechanics of a single particle and system of particles, constraints of motion, Principle of least action, generalized coordinates, principle of virtual work, D' Alemberts Principle, The Lagrangian formulation, Lagrangian for single and system of particles	15
II	Variational Principles and Langrange's Equations: Hamilton's principle, Calculus of variations, Langrange's equations, Hamilton principle, Lagranges equation from Hamilton principle.	15
III	Canonical Transformations: Canonical transformations, Poisson Bracket. Small oscillations and normal modes: Small oscillations about a stable equilibrium, Normal modes and their frequencies	15
IV	The Euler's angles, the Coriolis force and its applications, Inertia tensor, angular momentum of a rigid body, precision Euler's equation, symmetric and asymmetric top, noninertial frame of reference, rocket equation	15

Suggested Readings:

1. H. Goldstein, C. Poole & J. Safko, Classical Mechanics, Pearson Education Asia, New Delhi.
2. N. C. Rana and P. S. Joag, Classical Mechanics, Tata McGraw-Hill.
3. Kiran C. Gupta, Classical Mechanics of Particles & Rigid Bodies, Wiley Eastern.
4. L. Landau and E. Lifshitz, Mechanics Oxford.
5. S. N. Biswas, Classical Mechanics, Books and Allied (P) Ltd., Kolkata.
6. F. Scheck, Mechanics, Springer.
7. Problems and Solutions on Mechanics, World Scientific.
8. H. C. Corben and P. Stehle, Classical Mechanics, Dover.
9. T. W. B. Kibble, Classical Mechanics, Addison Wesley.

Suggestive digital platforms web links

This course can be opted as an elective by the students of following subjects:

Suggested Continuous Evaluation Methods:

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks
Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have had Physics and Maths in B.Sc.

Suggested equivalent online courses: NPTEL Lectures

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Program/Class: Master of Science in Physics (Electronics)	Year: First	Semester: I
Subject: Physics (Electronics)		
Course Code: B220703T	Course Title: Semiconductor Devices and Circuits	

Course Objectives:

The objective of the course is to introduce basic semiconductor devices, their characteristics and application, understand analysis and design of simple diode circuit learn to analyse the PN junction behaviour at the circuit level and its role in the operation of diodes and active device

Course outcomes:

After completion of this course, a student will be able to:
CO1: Ability to analyze PN junctions in semiconductor devices under various conditions.
CO2: Ability to design and analyze simple rectifiers and voltage regulators using diodes.
CO3: Ability to describe the behavior of special purpose diodes.
CO4: Ability to design and analyze simple BJT and MOSFET circuits.

Credits: 4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks: 40
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 3-1-0	

Unit	Topics	No. of Lectures
I	Diode and Applications: Diode - Static and Dynamic resistances, Equivalent circuit, Load line analysis, Diffusion and Transition Capacitances, Diode Applications: Switch-Switching times. Rectifier - Half Wave Rectifier, Full Wave Rectifier, Bridge Rectifier, Rectifiers with Capacitive and Inductive Filters, Clippers-Clipping at two independent levels, Clamper-Clamping Circuit Theorem, Clamping Operation, Types of Clampers.	15
II	Bipolar Junction Transistor (BJT): Principle of Operation, Common Emitter, Common Base and Common Collector Configurations, Transistor as a switch, switching times, Transistor Biasing and Stabilization - Operating point, DC & AC load lines, Biasing - Fixed Bias, Self Bias, Bias Stability, Bias Compensation using Diodes.	15
III	Junction Field Effect Transistor (FET): Construction, Principle of Operation, Pinch-Off Voltage, VoltAmpere Characteristic, Comparison of BJT and FET, Biasing of FET, FET as Voltage Variable Resistor. Special Purpose Devices: Zener Diode - Characteristics, Voltage Regulator. Principle of Operation - SCR, Tunnel diode, UJT, Varactor Diode FET Amplifiers: Small Signal Model, Analysis of JFET Amplifiers, Analysis of CS, CD, CG JFET Amplifiers. MOSFET Characteristics in Enhancement and Depletion mode, Basic Concepts of MOS Amplifiers.	15
IV	Analysis and Design of Small Signal Low Frequency BJT Amplifiers: Transistor Hybrid model, Determination of h-parameters from transistor characteristics, Typical values of h- parameters in CE, CB and CC configurations, Transistor amplifying action, Analysis of CE, CC, CB Amplifiers and CE Amplifier with emitter resistance, low frequency response of BJT Amplifiers, effect of coupling and bypass capacitors on CE Amplifier	15

Suggested Readings:

1. Electronic Devices and Circuits- Jacob Millman, McGraw Hill Education
2. Electronic Devices and Circuits theory– Robert L. Boylestead, Louis Nashelsky, 11th Edition, 2009, Pearson.
3. The Art of Electronics, Horowitz, 3rdEdition Cambridge University Press
4. Electronic Devices and Circuits, David A. Bell – 5 th Edition, Oxford.
5. Pulse, Digital and Switching Waveforms –J. Millman, H. Taub and Mothiki S. Prakash Rao, 2Ed., 2008, Mc Graw Hill.

This course can be opted as an elective by the students of following subjects: M.Sc. Physics

Suggested Continuous Evaluation Methods:

Total Marks: 25

House Examination/Test: 10 Marks

Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks

Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have basic circuit knowledge.

Suggested equivalent online courses:

https://nptel.ac.in/courses/108108112

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Program/Class: Master of Science in Physics (Electronics)	Year: First	Semester: I
Subject: Physics (Electronics)		
Course Code: B220704T	Course Title: Digital System Design	

Course Objectives:

This course is an introduction to the basic principles of digital system design. At the conclusion of this course, the student will be able to quantitatively identify the fundamentals of digital system design, including logic gates, logic and arithmetic subsystems, and integrated circuits. They will gain the practical skills necessary to work with digital circuits through problem solving and hands on laboratory experience with logic gates, encoders, flip-flops, counters, shift registers, adders, etc.

Course outcomes:

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

CO1: The student will be able to analyze and design simple logic circuits using tools such as Boolean algebra, Karnaugh Map and Tabulation method.

CO2: The student will able to design different combinational circuits.

CO3: The student will able to design different sequential circuits.

CO4: Ability to understand concept of logic families.

Credits: 4	Compulsory Course
Max. Marks: 25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 3-1-0

Unit	Topics	No. of Lectures
I	Analog & digital signals, AND, OR, NOT, NAND, NOR, XOR & XNOR gates, Boolean algebra, DeMorgan's theorems, Implementation of logical function using only NAND/NOR gates, 1's complement and 2's complement, Standard representation of logical functions (SOP and POS forms), K-map representation and simplification of logical function up to five variables, don't care conditions, XOR & XNOR simplifications of K-maps, Tabulation method.	16
II	Adders, Subtractor, Implementation of full adder using half adder, full subtractor using half subtractor, Multiplexer, de-multiplexer, decoder & encoder, code converters, 1- & 2-bit comparators, BCD to seven segment decoder/encoder, Implementation of logic functions using multiplexer/de-multiplexer and decoder, Implementation of 16×1 MUX using 4×1 MUX, 4×16 decoder using 3×8 decoder etc., logic implementations using PROM, PLA & PAL.	16
III	Difference between combinational and sequential circuits, Latch, Flip-flops: SR, JK, D & T flip flops – Truth table, Excitation table, Conversion of flip-flops, race around condition, Master Slave flip flop, Shift registers: SIPO, PISO, PIPO, SIPO, Bi-directional, 4-bit universal shift register; Counters: Asynchronous/ripple & synchronous up/down counters, Ring counter, Johnson counter, sequence detector.	18
IV	Logic families: Special characteristics (Fan out, Power dissipation, propagation delay, noise margin), working of RTL, DTL, TTL, ECL and CMOS families, their advantages and disadvantages.	10

Suggested Readings:

1. Moris Mano, Digital Design, Pearson Education.
2. R. P. Jain, Digital Electronics, Tata McGraw Hill.
3. Thomas L. Floyd, Digital Fundamentals, Pearson Education.
4. Malvino and Leech, Digital Principles & Applications, Tata McGraw Hill
5. William I. Fletche, An Engineering Approach to Digital Design

This course can be opted as an elective by the students of following subjects

Physics/Computer Science/ Mathematics/Statistics

Suggested Continuous Evaluation Methods:

Total Marks: 25

House Examination/Test: 10 Marks

Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks

Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have had the subject Physics/Electronics/Computer Science/ Mathematics/Statistics in class B.Sc

Suggested equivalent online courses:

1. MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning (NPTEL), https://www.youtube.com/user/nptelhrd
3. Uttar Pradesh Higher Education Digital Library, http://heecontent.upsdc.gov.in/SearchContent.aspx
8. SwayamPrabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program

Further Suggestions: .....

Program/Class: Master of Science in Physics (Electronics)	Year: First	Semester: I
Subject: Physics (Electronics)		
Course Code: B220705T	Course Title: Electronic Measurement and Instrumentation.	

Course Objectives:

The objective of the course is to provide a brief knowledge of measurements and measuring instruments related to Physics and Electronics. The basic idea of this course is to give the sufficient information of measurements in any kind of industry viz. electrical, electronics, mechanical etc.

Course outcomes:

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

CO1: Ability to analyze quality measurements with different digital display devices.

CO2: Understand the principles of various types of transducers and sensors with their practical application.

CO3: Ability to understand principle of operation of the data acquisition system and its industrial application and working.

CO4: Ability to understand principle of operation, working and applications of waveform analyzers, spectrum analyzers and other display devices

Credits:4	Elective
Max. Marks: 25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 3-1-0

Unit	Topics	No. of Lectures
I	Qualities Measurements and Digital Display Devices: Performance Characteristics, Error in Measurement, Sources of Error, Arithmetic Mean, Deviation from the Mean, Average Deviation, Standard Deviation, Limiting Errors. Digital Display Devices: LED, LCD, Gas Discharge Plasma Displays, Incandescent Display, LVD (Liquid Vapour Display), Printers, Digital Voltmeters, Spectrum Analyzer.	15
II	Introduction, Selection Parameters of Transducer, Resistive Transducer, Strain Gauges, Inductive Transducer, Differential Output Transducers, LVDT, Capacitive Transducer, Photo-electric Transducer, Photo cells, Photo-Voltaic Cell, Photo Transistors, Temperature Transducers, Mechanical Transducer.	15
III	Data Acquisition and Conversion: Introduction, Objective of Data Acquisition System, Multichannel DAS, A/D and D/A converters using Op-Amp, Data Loggers, Electromechanical A/D Converter, Digital Transducer, Frequency Standards	15
IV	Measurement of Power and Frequency: Introduction, Power Measurement by Bolometer element, Bolometer Mount and Bolometer Bridge, Measurement of Power on a Transmission Line, Measurement of Microwave Frequencies, Resonant Coaxial Lines, Cavity Wave meter.	15

Suggested Readings:

1. David A. Bell, "Electronic Instrumentation and Measurements", 2nd Ed., PHI, New Delhi 2008.
2. H. S. Kalsi, "Electronic Instrumentation", 3rd Ed., McGraw Hill Education (India),2015
3. AK Sawhney, "Electronic Measurements and Instrumentation

This course can be opted as an elective by the students of following subjects: M.Sc. Physics

Suggested Continuous Evaluation Methods:

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks
Class performance/Participation: 05 Marks

Course prerequisites: To study this course, a student must have basic knowledge of Functions, Matrix, Differentiation & Integration.

Suggested equivalent online courses:

https://nptel.ac.in/courses/111107105

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Program/Class: Master of Science in Physics (Electronics)	Year: First	Semester: I
Subject: Physics (Electronics)		
Course Code: B220706T	**Course Title: Programming in C**	

Course Objectives:

The objective of this course module is to acquaint the students with the basics of computer programming, get them familiar with various important features and concepts of C Language and problem-solving using programming in C.

Course outcomes:

At the end of this course, students will be

1. Able to understands the fundamentals of C programming and applications in problem solving.
2. Able to apply control structures and user defined functions for solving the problem
3. Able to apply the array for Strings and string handling operations.
4. Apply skill of identifying appropriate programming constructs for problem Solving.

Credits: 4	Elective
Max. Marks: 25+75	**Min. Passing Marks: 40**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 3-1-0

Unit	Topics	No. of Lectures
I	Introduction to computer-based problem solving, Programming language classification: Machine language, Assembly language, high level language, assemblers, compilers, interpreters. History of C, Introduction of C, Basic structure of C program, Concept of variables, constants and data types in C, Operators and expressions: Introduction, arithmetic, relational, Logical, Assignment, Increment and decrement operator, Conditional, bitwise operators, Expressions, Operator precedence and associativity. Managing Input and output Operation, formatting I/O.	15
II	C Statements, conditional executing using if, else, nesting of if, switch and break Concepts of loops, example of loops in C using for, while and do-while, continue and break. Storage types (automatic, register etc.), predefined processor, Command Line Argument.	15
III	One dimensional arrays and example of iterative programs using arrays, 2-D arrays Use in matrix computations. Concept of Sub-programming, functions Example of user defined functions. Function prototype, Return values and their types, calling function, function argument, function with variable number of argument, recursion.	15
IV	Pointers, relationship between arrays and pointers Argument passing using pointers, Array of pointers. Passing arrays as arguments. Strings and C string library. Structure and Union. Defining C structures, Giving values to members, Array of structure, Nested structure, passing strings as arguments. File Handling.	15

Suggested Readings:

1. E Balagurusamy, ANSI C.
2. Yashwant Kanetkar, Let us C, BPB Publications, 2nd Edition, 2001.
3. Herbert Schildt, C: The complete reference, Osbourne Mcgraw Hill, 4th Edition, 2002.
4. V. Raja Raman, "Computer Programming in C", Prentice Hall of India, 1995.
5. Kamthane, Programming with ANSI and Turbo C
6. Deitel, C – How to Program
7. Ritchie, The C Programming Language

8. K.K.Verma, Nidhi Asthana, Programming in C: A Primer, Shree Publishers, New Delhi
This course can be opted as an elective by the students of following subjects Physics/Computer Science/ Mathematics/Statistics
Suggested Continuous Evaluation Methods: Total Marks: 25 House Examination/Test: 10 Marks Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks Class performance/Participation: 05 Marks
Course prerequisites: To study this course, a student must have had the subject Physics/Electronics/Computer Science/ Mathematics/Statistics/Computer Application in B.Sc.
Suggested equivalent online courses: 1. MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/ 2. National Programme on Technology Enhanced Learning (NPTEL), https://www.youtube.com/user/nptelhrd 3. Uttar Pradesh Higher Education Digital Library, http://heecontent.upsdc.gov.in/SearchContent.aspx 8. SwayamPrabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program
Further Suggestions: .....

Program/Class: Master of Science in Physics (Electronics)	Year: First	Semester: I
Subject: Physics (Electronics)		
Course Code: B220707P	Course Title: Physics Laboratory -I (A)	
Course Objectives:		
The objective of the Laboratory is to provide practical exposure of basic logic gates and design of various combinational and sequential logic gates. The objective of electronic circuit lab is to provide students the knowledge of circuits operation and characteristics.		
Course outcomes:		
After completion of this course, a student will be able to: CO1: To enable students to design arithmetic and logic circuits design. CO2: The student will be able to design sequential logic circuits which are used in computer. CO3: The student will learn about the working of transistors. CO4: The student will be able to design amplifiers and oscillators using transistors which are part of electronic gadgets which are used day-to-day life.		
Credits: 5	Elective	
Max. Marks: 50+50	Min. Passing Marks: 40	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-10		

Group	Experiment	No. of Lab Hours
I	**Digital Electronics Lab** 1. To study and verify the truth table of all basic gate and universal gates. 2. a. To design all logic gates using NAND gate and verify truth table b. To design all logic gates using NOR gate and verify truth table. 3. To design the circuit & verify the truth table for a. Half and full adder using NAND IC-7400. b. Half and full subtractor using NAND IC-7400 4. To implement control circuit using multiplexer. 5. To design a circuit & verify the truth table of Gray to Binary & Binary to Gray converter code converter 6. To design a circuit & verify the truth table for a. SR Flip-flop b. JK Flip-flop c. Master slave JK Flip-flop 7. To design & verify the truth table for 4-Bit Ripple Up Counter. 8. To design & verify the truth table for 4-Bit synchronous Up Counter. 9. Open ended experiment –A. 10. Open ended experiment –B.	75
II	**Electronic Circuits Lab.** 1. To Draw characteristics curve of Field Effect Transistor (FET) and calculate its parameters. 2. To Draw characteristics curve of n channel and p channel enhancement MOSFET. 3. To study and plot the frequency response curve of the negative feedback in volateg and current series using BJT. 4. To study the frequency response of two stage transistorized RC coupled Amplifier and observe the loading effect of stage Two on stage One. 5. Characteristics of SCR. 6. Find the wave shape and frequency of a stable multivibrator with different combination. 7. Open ended experiment –A. 8. Open ended experiment –B.	75

Suggested Readings:

1. Jain—Modern Digital Electronics, TMH
2. Digital Logic Design- Morries Mano, PHI.
3. Jacob Millman, and C. C. Halkias, "Electronic devices and circuits", TMH Publications.
4. Ben G. Streetman, Solid State Electronic Devices, PHI, 5th Ed, 2001.
5. Donald P Leach, Albert Paul Malvino, Digital Principle and Applications, Seventh Edition, TMH Publications.
6. Mottershead, Electronic Devices and circuits; An Introduction Prentice Hall of India Private Limited (PHI), New Delhi

This course can be opted as an elective by the students of following subjects:

Suggested Continuous Evaluation Methods:

Total Marks: 50

Lab Record File (depending upon the no. of experiments performed out of the total assigned experiments): 20

marks for Viva Voce/Performance: 20

Class Interaction: 10
Course prerequisites: To study this course, a student must have basic circuit knowledge.
Suggested equivalent online courses: https://nptel.ac.in/courses/108108112
Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Program/Class: Master of Science in Physics (Electronics)	**Year: First**	**Semester: I**
Subject: Physics (Electronics)		
Course Code: B220708P	**Course Title:** Physics Laboratory -I (B)	
Course Objectives:		
The objective of the Laboratory is to provide practical exposure of basic logic gates and design of various combinational and sequential logic gates. The objective of electronic circuit lab is to provide students the knowledge of circuits operation and characteristics.		
Course outcomes:		
After completion of this course, a student will be able to: CO1: To enable students to design arithmetic and logic circuits design. CO2: The student will be able to design sequential logic circuits which are used in computer. CO3: The student will learn about the working of transistors. CO4: The student will be able to design amplifiers and oscillators using transistors which are part of electronic gadgets which are used day-to-day life.		
Credits: 5	**Elective**	
Max. Marks: 50+50	**Min. Passing Marks: 40**	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-10		

Group	Experiment	No. of Lectures
I	**Digital Electronics Lab** 1. To study and verify the truth table of all basic gate and universal gates 2. To design all logic gates using NOR gate and verify truth table. 3. To design the circuit & verify the truth table for a. Half and full adder using NOR gate only. b. Half and full subtractor using NOR gate only. 4. To implement 16: 1 multiplexer using 8: 1 and 2:1 multiplexer. 4. To design a circuit & verify the truth table of Excess-3 to Binary & Binary to Excess-3 code converter 5. To design a circuit & verify the truth table for a. SR Flip-flop b. D Flip-flop c. Master slave JK Flip-flop 6. To design & verify the truth table for 4-Bit Ring Counter.	**75**

	7. To design & verify the truth table for 4-Bit Asynchronous Up Counter. 9. Using Transistor, Diode and Resistor implement two input NAND gate. 9. Open ended experiment –A. 10. Open ended experiment –B.	
II	**Electronic Circuits Lab.** 1. To Draw characteristics curve of Field Effect Transistor (FET) and calculate its parameters. 2. To Draw characteristics curve of n channel and p channel enhancement MOSFET. 3. To study and plot the frequency response curve of the negative feedback in voltage and current shunt using BJT. 4. To study the frequency response of transistorized RC coupled Amplifier. 5. Characteristics of SCR. 6. Find the wave shape and frequency of a mono stable multivibrator with different combination. 7. Open ended experiment –A. 8. Open ended experiment –B.	75

Suggested Readings:

1. Jain—Modern Digital Electronics, TMH
2. Digital Logic Design- Morries Mano, PHI.
3. Jacob Millman, and C. C. Halkias, "Electronic devices and circuits", TMH Publications.
4. Ben G. Streetman, Solid State Electronic Devices, PHI, 5th Ed, 2001.
5. Donald P Leach, Albert Paul Malvino, Digital Principle and Applications, Seventh Edition, TMH Publications.
6. Mottershead, Electronic Devices and circuits; An Introduction Prentice Hall of India Private Limited (PHI), New Delhi

This course can be opted as an elective by the students of following subjects: M.Sc.Physics

Suggested Continuous Evaluation Methods:

Total Marks: 50
Lab Record File (depending upon the no. of experiments performed out of the total assigned experiments): 20
marks for Viva Voce/Performance: 20
Class Interaction: 10

Course prerequisites: To study this course, a student must have basic circuit knowledge.

Suggested equivalent online courses:

https://nptel.ac.in/courses/108108112

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

M.Sc. Physics (Electronics) Second Semester

Program/Class: Master of Science in Physics (Electronics)	Year: First	Semester: II
Subject: Physics (Electronics)		
Course Code: B220801T	Course Title: Electrodynamics	

Course Objectives:

The objective is to study about behaviour of moving particle in Electromagnetic field. The objective is to study about Electrodynamics

Course outcomes:

After completion of this course, a student will be able to:
CO1: Students will be able to understand tensor and its properties.
CO2: They will learn different representations used in Electrodynamics in four-dimensional space and their physical significance.
CO3: They will learn importance EM Field tensor and their correlations with Maxwell's equations.
CO4: They will be able to know understand the dynamics of charge particles in E.M. field, radiation of moving charge particles.

Credits:5	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks: 40
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-1-0	

Unit	Topics	No. of Lectures
I	Tensor analysis: General coordinate transformation; contravariant, covariant and mixed tensors; metric tensor; raising and lowering of indices; contraction of indices, four velocity, four acceleration	19
II	Covariant formulation of electromagnetism: Charge-current density four-vector; Scalar and Vector potentials; Gauge invariance; Electromagnetic potential four-vector; Electromagnetic field tensor; Lorentz transformation of electric and magnetic fields; Invariants of the electromagnetic field. EM field tensor and Maxwell's equation.	20
III	Radiation from a Moving Charge: Solution of Inhomogeneous Wave equation, Greens Functions, Lienard Wiechert Potentials and Field from a moving charge, Larmor's formula and its Relativistic Generalization	18
IV	Angular Distribution of Radiation from an Accelerated Charge, Electromagnetic Field and Radiation from an Oscillating Localized Source	18

Suggested Readings:

1. David J. Griffiths, Introduction to Electrodynamics, Prentice Hall India, New Delhi.
2. J.D. Jackson, Classical Electrodynamics, Wiley Eastern, New Delhi.
4. J.B. Marion and M.A. Heald, Classical Electromagnetic Radiation, Academic Press, San Diego.
5. Jordan & Balme, Electromagnetic Waves.
8. S. P. Puri, Classical Electrodynamics, Tata McGraw Hill, New Delhi.

Suggestive digital platforms web links

This course can be opted as an elective by the students of following subjects: M.Sc.....

Suggested Continuous Evaluation Methods:

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks
Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have had Physics and Maths in B.Sc.
Suggested equivalent online courses: NPTEL Lectures
Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Program/Class: Master of Science in Physics (Electronics)	Year: First	Semester: II
Subject: Physics (Electronics)		
Course Code: B220802T	Course Title: Quantum Mechanics	

Course Objectives:

The objective is to study about course is to make students aware about the basic formulations in quantum mechanics. There are many different types of representations of state and operators that are very useful in studying the subject deeply .....

Course outcomes:

After completion of this course, a student will be able to:
CO1: Students will be able to correlate the classical and quantum ideas.
CO2: They will learn different representations used in quantum mechanics and their physical significance.
CO3: They will learn importance of angular momentum observable in quantum mechanics.
CO4: They will be able come to know about time dependent & time-independent perturbation theory and their applications.

Credits:5	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-1-0

Unit	Topics	No. of Lectures
I	Linear vector space, Dirac's Bra-ket algebra, Matrix representation of observables and Harmonic Oscillator problem, Heisenberg Uncertainty principle, change of representation and states, Determination of eigen values and eigen state for observables using matrix representation, unitary transformation	19
II	Theory of angular momentum, Symmetries, invariance and conservation laws, relation between rotation and angular momentum. Commutation rules, matrix representation, Addition of angular momentum, C. G. coefficients (j_1=1/2, j_2=1/2).	20
III	Time independent perturbation theory (Non degenerate and degenerate case). Zeeman effect (normal), stark effect, The Variational Method and application to Helium atom and simple cases, WKB approximation	18
IV	Time dependent perturbation theory, Fermi's Golden rule, Semi-classical theory of radiation: Transition probability for absorption and induced emission, electric dipole and forbidden transition, selection rule	18

Suggested Readings:

1. L. I. Schiff Quantum Mechanics, Tata McGraw-Hill, Delhi.
2. B. Craseman and J.L. Powell Quantum Mechanics, Narosa, New Delhi.
3. S. Gasiorowicz Quantum Mechanics, Wiley, New York.

4. J. J. Sakurai Modern Quantum Mechanics, Addison Wesley.
5. P. M. Mathews & K.Venkatesan Quantum Mechanics, Tata McGraw-Hill, Delhi
6. Ghatak & Loknathan Quantum Mechanics
7. M. P. Khanna Quantum Mechanics, Har Anand, N. Delhi.
8. V. K. Thankappan Quantum Mechanics, New Age, N. Delhi.
9. N. Zettili Quantum Mechanics: Concepts and applications
10. Bransden and Jochain Quantum Mechanics
11. Satya prakash Quantum Mechanics
12. B. S. Rajput Advanced Quantum Mechanics
13. R. Shankar, Principles of Quantum Mechanics, Springer (India).
14. K. Gottfried and T-M Yan, Quantum Mechanics: Fundamentals,2nd Ed., Springer.
15. D. J. Griffiths, Introduction to Quantum Mechanics, Pearson Education.
16. F. Schwabl, Quantum Mechanics, Narosa.
17. E. Merzbacher, Quantum Mechanics, John Wiley (Asia).
19. B. H. Bransden and C. J. Joachain, Quantum Mechanics, Pearson Education 2nd Ed.

Suggestive digital platforms web links

This course can be opted as an elective by the students of following subjects: N.A. ……..

Suggested Continuous Evaluation Methods:

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks
Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have had Physics and Maths in B.Sc.

Suggested equivalent online courses:

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Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Program/Class: Master of Science in Physics (Electronics)	**Year: First**	**Semester: II**
Subject: Physics (Electronics)		
Course Code: B220803T	**Course Title: Microprocessor and Microcontrollers**	

Course Objectives:

This course deals with the systematic study of the Architecture and programming issues of 8085 and 8086 microprocessor family This also aim to provide the students with a basic understanding of instruction sets & assembly language programming of 8085/8086 processor. The course also aims to study of architecture of 8051 microcontroller and its application. This course will will provide sufficient knowledge to students about basic knowledge of the above microprocessor and system needed to develop the systems using it.

Course outcomes:

At the end of this course, students will be

1. Acquired knowledge about 8085 Microprocessor and supporting devices.
2. Able to write the assembly language programming using 8085 microprocessor.
3. Acquired knowledge about 8086 Microprocessor and also develop programming skill related to 8086 Microprocessor,

4. Students will be able to understand the concept and scope of 8051 microcontrollers, programming, interfacing of various external I/O devices, communication protocols used by microcontrollers and embedded system design.
5. Able to design microprocessor/microcontroller-based system using different peripheral devices.

Credits: 5	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-1-0

Unit	Topics	No. of Lectures
I	Introduction to Microprocessors and microcomputers, Study of 8-bit Microprocessor, 8085 pin configuration, Internal Architecture and operations, interrupts, Stacks and subroutines, addressing modes, Introduction to 8085 instructions set, advance 8085 programming, Counters and time Delays, Instruction cycle, machine cycle, T-states, timing diagram for 8085 instructions.	20
II	Block diagram and architecture of 8086 family, Execution unit, Bus Interface Unit, flags and register Organization, Physical Memory Organization, concept of memory segmentation, 8086 pin configuration, addressing modes of 8086 Instruction set and introduction to programming of 8086.	19
III	I/O interfacing and data transfer schemes, Interfacing with input/output devices (memory mapped, peripheral I/O), architectural details and study of peripheral devices 8255, 8253, 8257, 8259, 8251, IEEE 488 and RS232C	18
IV	Overview of 8051microcontroller family, the 8051 Architecture, 8051 Microcontroller Hardware, Input / Output Pins, Ports, Memory Organization, Special Function Registers, Timers/Counters, Serial Port Interface, Interrupt Structure, Addressing Modes, basic instructions, and introduction to programming of 8051.	18

Suggested Readings:

1. Ramesh. S. Gaonkar, "Microprocessor architecture Programming and Application with 8085" Penram International Publishing, 4th Edition.
2. Douglas V Hall. Microprocessor Interfacing, Tata Mc Hill.
3. B. Ram, "Fundamentals of microprocessors and microcomputer" Dhanpat Rai, 5th Edition.
4. Y.C. Liu and G.A. Gibson: Microcomputer Systems: The 8086/8088 Family Architecture.
5. M. Rafiquzzaman, "Microprocessor Theory and Application" PHI – 10th Indian Reprint.
6. R. Singh and B. P. Singh: Microprocessor Interfacing and Application, New Age International Publishers, 2nd Edition. 2. V. Hall: Microprocessors Interfacing, TMH (2ndEdition).
7. Kenneth J Ayala, The 8051Microcontroller, Penram International Publishing.
8. M.A. Mazidi and J. G. Mazidi, 2004 "The 8051 Microcontroller and Embedded Systems", PHI.
9. R. Kamal, "Embedded Systems: Architecture, Programming & Design", 2007, McGraw Hill, USA 2007.
14. Dr. Rajiv Kapadia, "8051 Microcontroller & Embedded Systems", Jaico Press

This course can be opted as an elective by the students of following subjects

Physics/Computer Science/ Mathematics/Statistics

Suggested Continuous Evaluation Methods:

Total Marks: 25

Internal Test: 10 Marks

Home Assignment/Presentation /Project / Research Orientation/ Term Papers/Seminar: 10 Marks Class performance/Participation: 5 Marks
Course prerequisites: To study this course, a student must have had the subject Physics/Electronics/Computer Science/ Mathematics/Statistics/Computer Application in class B.Sc.
Suggested equivalent online courses: **1.** MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/ 2. National Programme on Technology Enhanced Learning (NPTEL), https://www.youtube.com/user/nptelhrd 3. Uttar Pradesh Higher Education Digital Library, http://heecontent.upsdc.gov.in/SearchContent.aspx 4. SwayamPrabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program
Further Suggestions: .....

Program/Class: Master of Science in Physics (Electronics)	**Year: First**	**Semester: II**
Subject: Physics (Electronics)		
Course Code: B220804T	**Course Title:** Introduction to MATLAB Programming	
Course Objectives:		
The objective of this course is to impart knowledge of MATLAB and its application in computing. This course will provide opportunities for learning of programing and simulation aspects of MATLAB.		
Course outcomes:		
After completion of this course, a student will be able to: **CO1: Describe the Introduction to MATLAB.** **CO2: Apply matrix manipulations and perform different types of operations on matrices** **CO3: Applications of statistics & probability in real life domain.** **CO4: Learn statistical techniques through different tools and apply it to case studies using the concepts learned in the class.**		
Credits: 5	**Elective**	
Max. Marks: 25+75	**Min. Passing Marks: 40**	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-1-0		

Unit	Topics	No. of Lectures
I	Introduction to MATLAB, MATLAB windows, Input-output, File types, Platform dependence, General commands, Creating and Working with Arrays of Numbers, Creating and Printing Simple Plot, change in axes and annotation, multiple plots, Creating, Saving, and Executing a Script File, Editing, saving m-files, Creating and Executing a Function File, introduction to some inbuilt functions.	18
II	Flow control using various statements and loops including For-End and While-End loops with Break commands. Conditional Statements: If-End statement, If-Else-End statement. Scripts and user defined functions, calling functions into a script, subfunctions, and nested functions, concept of local and global variable.	20
III	Vector and Matrix generation, subscripting and the colon notation,	17

	matrix and array operations and their manipulations, arithmetic operators, relational operators, logical operators, solution of matrix equation, Inverse of Matrix, Eigen values and Eigen Vectors, Determinant, Elementary math functions, Matrix functions,	
IV	Two & three-dimensional graphics: basic plots, change in axes and annotation, multiple plots, saving and printing, mesh plots, surface plots and their variants, data representation, Introduction Of GUI, GUI Component Design, Introduction to Simulink.	20

Suggested Readings:

1. Applied Numerical Methods with Matlab for Engineers and Scientists by Steven Chapra, McGraw Hill, 2008.
2. MATLAB: An introduction with applications: Amos Gilat, 5th Edition, Wiley India, 2014.
3. Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers by RudraPratap, Oxford University Press, 2016

This course can be opted as an elective by the students of following subjects: M.Sc. Physics

Suggested Continuous Evaluation Methods:

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks
Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have basic knowledge of Functions, Matrix, Differentiation & Integration.

Suggested equivalent online courses:

https://nptel.ac.in/courses/111107105

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Program/Class: Master of Science Physics (Electronics)	**Year: Second**	**Semester: II**
Subject: Physics (Electronics)		
Course Code: B220805T	**Course Title:** Computer Oriented Numerical Method.	

Course Objectives:

The objective of the course is s to enable students to obtain an intuitive and working understanding of numerical methods for the basic problems of numerical analysis and gain an experience in the implementation of numerical methods using a computer.

Course outcomes:

After completion of this course, a student will be able to:
CO1: Concept cause & consequence of errors in the application of numerical computing.
CO2: Numerical techniques for solving various problems.
CO3: Applications of statistics & probability in real life domain.
CO4: Learn statistical techniques through different tools and apply it to case studies using the concepts learned in the class.

Credits: 5	Elective
Max. Marks: 25+75	**Min. Passing Marks: 40**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-1-0

Unit	Topics	No. of Lectures
I	Computer Arithmetic, Errors in numbers, Iterative methods- successive bisection, Hall's position and Newton Raphson Iterative method for finding roots of a polynomial. Comparison of iterative methods.	20
II	Interpolation techniques, Lagrange interpolation, least square approximation of function, linear regression and polynomial curve fitting.	19
III	Simultaneous Equations solving – The Gauss elimination method pivoting, Ill conditioned equations, Eigen values computations	18
IV	Numerical differentiation and Integration, Simpson's 1/3 rule, Solution of differential equations, Euler's Method, Taylor series method, Runge Kutta Methods	18

Suggested Readings:

1. C. K. Kumbharana & Dr N. N. Jani, Computer Oriented Numerical Methods.
2. M. K. Jain and R. K. Jain, Numerical Methods – Problems and Solutions.
3. S. S. Sastry, Introductory Methods of Numerical Analysis, PHI publications.
4. V. Rajaraman, Computer Oriented Numerical Methods, PHI publications.

This course can be opted as an elective by the students of following subjects: M.Sc. Physics

Suggested Continuous Evaluation Methods:

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks
Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have basic knowledge of Functions, Matrix, Differentiation & Integration.

Suggested equivalent online courses:

https://nptel.ac.in/courses/111107105

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Program/Class: Master of Science in Physics (Electronics)	Year: First	Semester: II
Subject: Physics (Electronics)		
Course Code: B220806P	Course Title: **Physics** Laboratory Course -II (A)	

Course Objectives:

The objective of the Laboratory is to introduce the practical aspect of operational amplifier its characteristics and uses in IC. The objective of microprocessor 8085 is to provide awareness of programming of 8085.

Course outcomes:

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

CO1: The student will be able to know about characteristics of IC741and its applications. CO2: The student will be able to design Astable and monostable multivibrator using IC555. CO3: The student will be able to know about the programming of microprocessor 8085. CO4: The student will be able to know about the applications of microprocessor 8085.	
Credits:5	**Core Compulsory**
Max. Marks: 50+50	**Min. Passing Marks: 40**
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-10	

Group	Experiment	No. of Lab Hours
I	Operational Amplifier Experiments 1. To determine the following parameter of 741 IC a. Input offset voltage. b. Input offset current. c. Common mode rejection ratio (CMRR). 2. Design adder and Subtractor using 741 Operational Amplifier. 3. Design Differentiator and Integrator using 741 Operational Amplifier 4. Design astable and monostable multivibrator using IC555. 5. Open ended experiment –A. 6. Open ended experiment –B.	75
II	Microprocessor 1.Write an Assembly language program using 8085 Microprocessor: a. Addition of two 8-bit numbers. b. Addition of two 16-bit numbers. 2. Write an Assembly language program using 8085 Microprocessor Subtraction of two 8-bit numbers: a. Using 'SUB' instruction. b. Using 1's Complement c. Using 2's Complement. 3.Write an Assembly language program using 8085 Microprocessor for Multiplication and Division of two 8-bit numbers. 4.Write an Assembly language program using 8085 Microprocessor for to transfer block of data from one memory location to other. 6. Write an Assembly language program using 8085 Microprocessor for to find the largest number in an array of data. 7. Open ended experiment –A. 8. Open ended experiment –B.	75

Suggested Readings:

1. Ramakant A. Gayakwad, Op-Amps and Linear Integrated Circuits, Fourth Edition By Pearson
2. Operational Amplifiers Theory and Design by Johan Huijsing , Springer
3. Fundamentals of Microprocessor and Microcomputer: B. Ram.
4. Microprocessor Architecture Programming and Application: R.S. Goanker.
5. Introduction to Microprocessor: A.P. Mathur.

This course can be opted as an elective by the students of following subjects:

Suggested Continuous Evaluation Methods:
Total Marks: 50 Lab Record File (depending upon the no. of experiments performed out of the total assigned experiments): 20 marks for Viva Voce/Performance: 20 Class Interaction: 10
Course prerequisites: To study this course, a student must have basic circuit knowledge and Digital Electronics/Programming Skill.
Suggested equivalent online courses: https://nptel.ac.in/courses/108108112
Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Program/Class: Master of Science in Physics (Electronics)	Year: First	Semester: II
Subject: Physics (Electronics)		
Course Code: B220807P	Course Title: Physics Laboratory Course -II (B)	
Course Objectives:		
The objective of the Laboratory is to introduce the practical aspect of operational amplifier its characteristics and uses in IC. The objective of microprocessor 8085 is to provide awareness of programming of 8085.		
Course outcomes:		
After completion of this course, a student will be able to: CO1: The student will be able to know about characteristics of IC741and its applications. CO2: The student will be able to design Astable and monostable multivibrator using IC555. CO3: The student will be able to know about the programming of microprocessor 8085. CO4: The student will be able to know about the applications of microprocessor 8085.		
Credits:5	Core Compulsory	
Max. Marks: 50+50	Min. Passing Marks: 40	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-10		

Group	Experiment	No. of Lab Hours
I	Operational Amplifier Experiments 1. Design of differential amplifier. 2. To study the op amp as an adder, subtractor, integrator and differentiator. 3. To design low pass, high pass and band pass filters using op- amp. and plot their frequency response. 4. Design astable and monostable multivibrator using IC555. 5. To design RC phase shift and Wein bridge oscillators using op amplifier. 5. Open ended experiment –A.	75

	6. Open ended experiment –B.	
II	Microprocessor 1. Write an Assembly language program using 8085 Microprocessor: (a) Addition of two 8-bit numbers. (b) Addition of two 16-bit numbers. 2. Write an Assembly language program using 8085 Microprocessor Subtraction of two 8-bit numbers. 3. To convert two BCD numbers in memory to the equivalent HEX number using 8085 instructions set. 4. Write an Assembly language program using 8085 Microprocessor for Multiplication and Division of two 8-bit numbers. 5. Write an Assembly language program using 8085 Microprocessor for to transfer block of data from one memory location to other. 6. Write an Assembly language program using 8085 Microprocessor for to find the smallest number in an array of data. 7. Open ended experiment –A. 8. Open ended experiment –B.	**75**

Suggested Readings:

6. Ramakant A. Gayakwad, Op-Amps and Linear Integrated Circuits, Fourth Edition By Pearson
7. Operational Amplifiers Theory and Design by Johan Huijsing , Springer
8. Fundamentals of Microprocessor and Microcomputer: B. Ram.
9. Microprocessor Architecture Programming and Application: R.S. Goanker.
10. Introduction to Microprocessor: A.P. Mathur.

This course can be opted as an elective by the students of following subjects:

Suggested Continuous Evaluation Methods:

Total Marks: 50
Lab Record File (depending upon the no. of experiments performed out of the total assigned experiments): 20
marks for Viva Voce/Performance: 20
Class Interaction: 10

Course prerequisites: To study this course, a student must have basic circuit knowledge and Digital Electronics/Programming Skill.

Suggested equivalent online courses:

https://nptel.ac.in/courses/108108112

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

M.Sc Physics (Electronics) Second Year Third Semester

Program/Class: Master of Science in Physics (Electronics)	Year: Second	Semester: III
Subject: Physics (Electronics)		
Course Code: B220901T	Course Title: Thermodynamics & Statistical Mechanics	

Course Objectives:

Students will be able to employ fundamental physics concepts and theories to set up and formulate problems in thermodynamics and statistical mechanics. Students will be able to apply differential and integral calculus, differential equations, and elementary concepts form probability theory to solve problems in thermodynamics and statistical mechanics.

Course outcomes:

After completion of this course, a student will be able to:
CO1: They will know about different types of ensembles
CO2: They will understand about different types of distribution functions and their applications.
CO3: They will know about different type of phase transitions.
CO4: They will come to know about diffusion and Brownian motion also.

Credits:4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 3-1-0

Unit	Topics	No. of Lectures
I	Thermodynamics: Entropy and probability; Thermodynamic potentials - Helmholt, Gibbs, Enthalpy and Internal energy; Equilibrium conditions for an isolated system; Third law of thermodynamics. Thermodynamics of first and second order phase transition, Clausius-Clapeyron and Ehrenfest's equations; Chemical potential and phase equilibria.	15
II	Microcanonical, Canonical and Grand canonical ensemble, partition function, thermodynamic functions, mean energy, pressure and free energy, entropy in terms of probability, Gibb's paradox, Sakur-Tetrode expression, equivalence of three equilibrium ensembles, fluctuations in energy and particle number in canonical and grand canonical ensembles	15
III	Maxwells, BE and FD distribution, functions, evaluation of partion function for ideal gas, Ideal Bose gas, Photon gas, Ideal Fermi gas and its examples(condition in metal)	15
IV	First and second order phase transitions, Clausius-Clyperon equation, critical indices, order parameter, Landau theory of phase transition, cooperative phenomena, Ising model, Bragg-William approximation, one dimensional Ising modelDynamic correlation and response function, example of damped harmonic oscillator, Diffusion, Brownian motion (Langevin theory)	15

Suggested Readings:

1. R.K. Patharia, Statistical Mechanics, 2nd edition, Butterworth Heinemann, Oxford.
2. K. Huang, Statistical Mechanics, Wiley Eastern, New Delhi.
3. B. K. Agarwal and M. Eisner, Statistical Mechanics, Wiley Eastern, New Delhi.
4. C. Kittel, Elementary Statistical Physics, Wiley, New York.
5. S.K. Sinha, Statistical Mechanics, Tata McGraw Hill, New Delhi.
6. S. R. A. Salinas, Introduction to Statistical Physics, Springer.
7. Suresh Chandra, A textbook of Statistical Mechanics, CBS Publishers, New Delhi.

8. F. Reif,, Fundamentals of Statistical and Thermal Physics, Levant Books
9. L. D. Landau and E. M. Lisfsitz, Statistical Physics.
10. S. K. Ma, Statistical Mechanics, World Scientific Publishing Company.
11. D. Chowdhury and D. Stauffer, Principles of Equilibrium Statistical Mechanics.
12. L. E. Reichel, A modern course in statistical physics, 2nd edition.

Suggestive digital platforms web links

This course can be opted as an elective by the students of following subjects: N.A ……..

Suggested Continuous Evaluation Methods:

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks
Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have had Physics and Maths in B.Sc.

Suggested equivalent online courses:

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Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Program/Class: Master of Science in Physics (Electronics)	**Year: Second**	**Semester: III**
Subject: Physics (Electronics)		
Course Code: B220902T	**Course Title: Advanced Quantum Mechanics**	

Course Objectives:

Describe the basic of scattering, quantum field theories, Model physical systems using common approximation techniques for making dynamical calculations.

Course outcomes:

After completion of this course, a student will be able to:
CO1: They will be able to tackle identical particle problems
CO2: They will be able that how scattering is used as a tool for investing different phenomena occurring at atoic and nuclear level.
CO3: They will be able to understand relativistic quantum mechanics.
CO4: They will be able to understand quantum representation of fields.

Credits:4	**Core Compulsory**
Max. Marks: 25+75	**Min. Passing Marks: 40**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 3-1-0

Unit	Topics	No. of Lectures
I	Identical particles: Symmetric and antisymmetric wave functions, distinguishability of identical particles, Pauli's exclusion principle, connection with statistical mechanics, collisions of Identical particles. Spin angular momentum: connection between spin and statistics, spin matrices and eigen functions. Spin functions for many electron system, Atomic levels of Helium atoms as an example of two electron system, Slater determinant.	15

II	Scattering theory, Scattering amplitude and cross-section partial wave analysis and application to simple cases, Greens function, Born approximation, validity and simple application, Its application to Yukawa potential and other simple potentials, Electron scattering from a nuclei, form factor and nuclear radius.	**15**
III	Klein Gordon equation, Dirac equation for a free particle and its solution, interpretation of negative energy states, non relativistic approximation to the Dirac's equation, Existence of spin, fine structure effects, solution of Dirac's equation for hydrogen atom, Magnetic Moment.	**15**
IV	Field quantization, Lagrangian density and equation of motion for field, Canonical quantization of scalar field, Complex scalar field, Electromagnetic and Dirac fields.	**15**

Suggested Readings:

1. L.I. Schiff, Quantum Mechanics, Tata McGraw-Hill.
2. S. Gasiorowicz, Quantum Physics, Wiley, New York.
3. Craseman and J.D. Powell, Quantum Mechanics, Narosa, New Delhi.
4. A.P. Messiah, Quantum Mechanics.
5. J.J. Sakurai, Modern Quantum Mechanics, Addison Wesley.
6. P. M. Mathews & K. Venkatesan, A Text book of Quantum Mechanics, Tata McGraw Hill.
7. Ghatak & Loknathan,.Quantum Mechanics.
8. Chhen Tannoudji,.Quantum Mechanics.
9. M. P. Khanna, Quantum Mechanics, Har Anand, New Delhi.
10. J. L. Powell and B. Crasemann, Quantum Mechanics, Narosa.
11. R. P. Feynman, The Feynman Lectures on Physics vol. III, Pearson.
12. Amitabh Lahiri and P. B. Pal., A first book on Quantum field theory.

Suggestive digital platforms web links

This course can be opted as an elective by the students of following subjects: N.A. .....

Suggested Continuous Evaluation Methods:

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks
Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have had Physics and Maths in B.Sc.

Suggested equivalent online courses:

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Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Program/Class: Master of Science in Physics (Electronics)	**Year: Second**	**Semester: III**
Subject: Physics (Electronics)		
Course Code: B220903T	**Course Title: Communication Theory and Systems**	

Course Objectives:

The purpose of this course is to provide a thorough introduction to analog, digital communications and computer communication with an in-depth study of various modulation techniques. This course also intends to impart students with technical knowledge of Data communication Networks. This Course provides complete understanding of OSI and TCP model along with requisite protocols in all layers.

Course outcomes:

At the end of this course, students will be

1. Able to understand the basic concept of analog communication system and analyze the various amplitude modulation, Frequency and Phase modulation schemes.
2. Able to describe and analyze the various pulse modulation and multiplexing techniques for the digital transmission of analog signal.
3. Able to identify and describe different techniques in modern digital communications.
4. Able to describe and analyze the various pulse modulation and the digital transmission of analog signals.
5. Able to identify and describe different techniques in modern digital communications,
6. Able to understand fundamentals of computer networks, communication protocols, layered network architectures.
5. Able to understand the functionality of CSMA/CD, IP & TCP/UDP and HTTP Protocols.

Credits:4	**Core Compulsory**
Max. Marks: 25+75	**Min. Passing Marks:40**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 3-1-0

Unit	Topics	No. of Lectures
I	Communication Process, Source of Information, base-band and pass-band signals, Elements of a Communication System, analog versus digital communication, Need of modulation and typical applications, types of Modulation and demodulation.	15
II	Amplitude modulation with full carrier, suppressed carrier systems, single side band transmission, switching modulators, synchronous detection, envelope detection, comparison of various AM systems, vestigial side band transmission, introduction to angle modulation, Narrow and wide band FM, BW calculations using Carson rule, Direct & Indirect FM generations, phase modulation, Demodulation of FM signals, noise reduction using pre & de-emphasis.	15
III	Pulse Modulation and Digital Modulation: Sampling Theorem and its applications, Concept of Pulse Amplitude Modulation, Pulse width modulation and pulse position modulation, PCM, Signal to quantization ratio in PCM, Delta Modulation, Adaptive delta-modulation Modulation and Demodulation in Digital modulation schemes- Introduction to ASK, FSK, PSK, DPSK, QPSK.	15
IV	Introduction to Computer Communication, Network Basics- Concept, Types, Transmission modes, Topologies, OSI & TCP/IP Models: Functions of different Layers, concept of MAC, IP (Private/Public) and TCP addresses, Basic Introduction to CSMA/CD, IP & TCP/UDP and HTTP Protocols, Current Internet Applications	15

Suggested Readings:

1. H. Taub, D L Schilling, Goutom Saha, "Principles of Communication", 3e, Tata McGraw-Hill Publishing Company Ltd.
2. B.P. Lathi, "Modern Digital and Analog communication Systems", 3e, Oxford University Press,2009.
3. Simon Haykin, "Communication Systems",4e, Wiley India.
4. H. P. HSU & D. Mitra, "Analog and Digital Communications", 2e, Tata McGraw-Hill Publishing Company Ltd.
5. Singh, R.P. &Sapre, S.D. "Communication Systems: Analog & Digital", Tata McGraw-Hill.
6. Behrouz A. Forouzan, Data communication and Networking, Tata McGraw-Hill, India.
7. A.S. Tanenbaum, Computer Networks (2003), 5 ed, Pearson Education/ PHI. New Delhi, India.

This course can be opted as an elective by the students of following subjects Physics/Computer Science/ Mathematics/Statistics
Suggested Continuous Evaluation Methods: Total Marks: 25 Internal Test: 10 Marks Home Assignment/Presentation /Project / Research Orientation/ Term Papers/Seminar: 10 Marks Class performance/Participation: 5 Marks
Course prerequisites: To study this course, a student must have had the subject Physics/Electronics/Computer Science/ Mathematics/Statistics/Computer Application in class B.Sc.
Suggested equivalent online courses: 1. MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/ 2. National Programme on Technology Enhanced Learning (NPTEL), https://www.youtube.com/user/nptelhrd 3. Uttar Pradesh Higher Education Digital Library, http://heecontent.upsdc.gov.in/SearchContent.aspx 8. SwayamPrabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program
Further Suggestions: .....

Program/Class: Master of Science in Physics (Electronics)	**Year: Second**	**Semester: III**
Subject: Physics (Electronics)		
Course Code: B220904T	**Course Title: Condensed Matter Physics**	
Course Objectives:		
Demonstrate knowledge of fundamental aspects of the structure of the nucleus, radioactive decay, nuclear reactions and the interaction of radiation and matter.		
Course outcomes:		
After completion of this course, a student will be able to: CO1: They will have clear understanding about structure and structure related properties of solids. CO2: They will understand different models of solids and about superconductors. CO3: They will understand about different parameters of dielectrics. CO4: They will gain knowledge about different types of dielectric materials and also about ferromagnetic materials.		
Credits:4	**Core Compulsory**	
Max. Marks: 25+75	**Min. Passing Marks: 40**	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 3-1-0		

Unit	Topics	No. of Lectures
I	Amorphous and Crystalline solids, Direct lattice, translational vectors, two and three dimensional Bravais latices, Miller Indices, Reciprocal lattice, Braggs Law, Brillouin zones. Vibrations of mono and diatomic lattices, lattice heat capacity, Einstein and Debye models, acoustical and optical phonons, phonon momentum, Inelastic scattering by phonons.	15
II	Nearly free electron model, Kronig-Penny model, Bloch-theorem, bonding in solids, tight binding approximations. Fermi surface, Conduction in Semiconductors (both Intrinsic and Extrinsic), Hall effect, Superconductivity, Different Properties of Superconductors:	15

	Meissner effect, London equation, BCS theory, Josephson effect, High Temperature Superconductor,	
III	Dielectrics, Parameters for dielectrics (Dielectric constant, dipole moment polarization, polarizability), mechanism of polarization. Permanent dipole moment, Space charge polarization. Internal field and its expression, Clausius Mossotti relation, Maxwell relation, Debye's quantization of Clausius Mossotti equation,	**15**
IV	Classification of dielectrics: piezoelectric, pyroelectric, Ferroelectric, Paraelectric materials, Real and imaginary dielectric constants, Dielectric losses, Effect of frequency and polarization, Ferromagnetic material, Ferromagnetic domain.	**15**

Suggested Readings:

1. C. Kittel, Introduction to Solid State Physics, Wiley, New York.
2. C. Kittel, Quantum Theory of Solids, Wiley, New York.
3. Verma and Srivastava, Crystallography for Solid-State Physics.
4. J. Ziman, Principles of the Theory of Solids, Cambridge University Press, Cambridge.
5. Azaroff, Introduction to Solids.
6. Omar, Elementary Solid-State Physics.
7. Aschroft & Mermin, Solid State Physics, Reinhert & Winston, Berlin.
8. Chaikil & Lubensk, Principles of Condensed Matter Physics.
9. M. Tinkham, Introduction to Superconductivity.
10. S. O. Pillai, Solid State Physics, New Age International Publishers.
11. M. A. Wohab Soild State Physics, Narosa.
12. H. Ibach and H. Luth, Solid State Physics, Springer.

Suggestive digital platforms web links

This course can be opted as an elective by the students of following subjects: N.A. ……..

Suggested Continuous Evaluation Methods:

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks
Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have had Physics and Maths in B.Sc.

Suggested equivalent online courses:

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Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Program/Class: Master in Science in Physics (Electronics)	**Year: Second**	Semester: III
Subject: Physics (Electronics)		
Course Code: B220905T	**Course Title: Analog Integrated Circuits**	

Course Objectives:

The objective of the course is to understand the basic components and methodologies used for Analog Design. Most of the portion deals with OPAMP based circuits and Applications.

Course outcomes:

After completion of this course, a student will be able to:
CO1: Thorough understanding of operational amplifiers
CO2: To design circuits using operational amplifiers for various applications.
CO3: Explain the working and applications of timer, VCO and PLL IC

CO4: Design Oscillators and active filters using Op-Amps.	
Credits:4	**Elective**
Max. Marks: 25+75	**Min. Passing Marks:40**
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 3-1-0	

Unit	Topics	No. of Lectures
I	OPERATIONAL AMPLIFIERS: Basic differential amplifier analysis, Single ended and double ended configurations, Op-amp configurations with feedback, Op-amp parameters, and Inverting and Non-Inverting configuration, Comparators, Adder.	15
II	OPERATIONAL AMPLIFIER APPLICATIONS: Integrator, Differentiator, Voltage to frequency & Frequency to voltage converters. Oscillators: Phase shift, Wien bridge, Quadrature, square wave, triangular wave, saw tooth oscillators. Voltage controlled oscillators. The 555 timer as astable and monostable multivibrators. Zero crossing detector, Schmitt trigger	15
III	ACTIVE FILTERS: Low pass, high pass, band pass and band reject filters, All pass filter, Switched capacitor filter, Butterworth filter design, Chebyshev Filter design.	15
IV	PHASE-LOCKED LOOPS: Operating Principles of PLL, Linear Model of PLL, Lock range, Capture range, Applications of PLL as FM detector, FSK demodulator, AM detector, Frequency translator, phase shifter, tracking filter, signal synchronizer and frequency synthesizer, Building blocks of PLL, LM565 PLL , Four quadrant multiplier & its applications, Basic blocks of linear IC voltage regulators	15

Suggested Readings:

1. I. R. A. Gayakwad - Op-amplifiers & Linear ICs, Pearson Education.
2. J.M. Jacob – Applications & Design with Analog Integrated Circuits, Prentice Hall of India.
3. RAMAKALYAN: LINEAR CIRCUITS (Includes CD), Oxford
4. K.R. Botkar – Integrated Circuits, Khanna Publications.
5. Shail and Jain, Linear Integrated Circuit

This course can be opted as an elective by the students of following subjects: M.Sc. Electronics

Suggested Continuous Evaluation Methods:

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks
Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have basic circuit knowledge.

Suggested equivalent online courses:
https://onlinecourses.nptel.ac.in/noc22_ee15/preview

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Program/Class: Master in Science in Physics (Electronics)	Year: Second	Semester: III
Subject: Physics (Electronics)		
Course Code: B220906T	Course Title: Materials: Introduction, Synthesis and Processing	

Course Objectives:

Explain the principles of synthesising solid materials by various routes, e.g. from solid phase, solution, melts, gas phase explain the principles behind and the type of information that different characterisation techniques provide evaluate the strengths and limitations of various synthesis and characterisation methods.

Course outcomes:

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

CO1: Students will be able to understand the Types of materials.

CO2: They will learn different approaches used in Synthesis of materials.

CO3: They will learn use and importance of different type of materials.

CO4: They will be able understand various characterization techniques.

Credits: 4	Elective
Max. Marks: 25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 3-1-0

Unit	Topics	No. of Lectures
I	Introduction to materials: Metals and alloy, Ceramics, Composites Nano-materials and bio materials, etc. Ceramic powder synthetic methods: Diffusion; (Laws of diffusion, Types of diffusion, Fick's law, Diffusion in ionic solids, Role of diffusion in solid state reactions and sintering), Solid state reaction method.	20
II	Synthesis of Materials: Chemical reduction, Reactions in micelles, Emulsions and dendrimers, Photochemical and radiation chemical reduction, Cryochemical synthesis, Sonochemical methods and Physical methods, Chemical method, Co-precipitation, Spray drying, Freeze drying, Sol-gel method, Hydrothermal, Combustion and Microwave synthesis	15
III	Biomaterials: Biocompatibility, Bone composition and properties, Hydroxyapatite and calcium phosphate biomaterials, Bioceramics, Bioglasses and biocompatible polymer materials.	10
IV	Characterization Techniques for Materials: XRD-X-ray Diffraction, X-ray photoelectron spectroscopy (XPS), Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Atomic force microscopy (AFM), Thermo gravimetric analysis (TGA), Differential thermal analysis (DTA), differential scanning calorimetry (DSC), Raman spectroscopy, UV/Vis/IR and FTIR spectroscopy, Photoluminescence (PL) Spectroscopy. (only Introductory)	15

Suggested Readings:

1. V. Raghavan, Materials Science and Engineering: A First Course, Prentice-hall India Pvt. Ltd.

2. W. D. Callister, Materials Science And Engineering: An Introduction, 7th Ed, Wiley India

3. W.O. Gonzalez -Vinas, Hector L. Mancini, An Introduction To Materials Science, Princeton University Press, 2004.

4. C.N.R. Rao, P. John Thomas, G. U. Kulkarni, Nanocrystals: Synthesis, Properties and Applications, Springer, 2011.
5. P. K. Ghosh, Introduction to Photoelectron Spectroscopy (Chemical Analysis Vol. 67) Wiley Interscience, 1983.
6. J. F. Watts, John Wolstenholme, An Introduction to Surface Analysis by XPS and AES, John Wiley & Sons Ltd., 2003.
7. R. Egerton, Physical Principles of Electron Microscopy: An Introduction To TEM, SEM, And AEM; Springer, 2005
8. D. B. Williams, C. Barry Carter, Transmission Electron Microscopy: A Textbook for Materials Science, Springer, 2009.
9. P. R. Buseck, John M. Cowley, Leroy Eyring, High-resolution Transmission Electron Microscopy: And Associated Techniques, Oxford University Press, 1989
10. Günther Höhne, Wolfgang F. Hemminger and H. J. Flammersheim, Differential Scanning Calorimetry, 2nd ed., Springer 2003.

Suggestive digital platforms web links

This course can be opted as an elective by the students of following subjects: M.Sc. PHYSICS

Suggested Continuous Evaluation Methods:

Total Marks: 25

House Examination/Test: 10 Marks

Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks

Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have had Physics and Maths in B.Sc.

Suggested equivalent online courses: NPTEL Lectures

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Program/Class: Master of Science in Physics (Electronics)	**Year: Second**	**Semester: III**
Subject: Physics (Electronics)		
Course Code: B220907P	**Course Title:** Physics Laboratory Course -III (A)	

Course Objectives:

The objective of the Laboratory is to provide practical exposure of communication by various technique and applications. The objective of microprocessor 8086 lab is to provide awareness of programming of 8086.

Course outcomes:

After completion of this course, a student will be able to:
CO1: The student will be able to know about various technique of communication.
CO2: The student will be able to application of various techniques in different condition.
CO3: Students will become familiar with the free-electron model for metals and use the concept of Fermi energy and Fermi temperature.
CO4: Students will accrue basic knowledge and practical exposure of the Solid-State physics.

Credits: 5	Core Compulsory
Max. Marks: 50+50	Min. Passing Marks: 40
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-10	

Group	Experiment	No. of Lab Hours
I	Communication Lab. 1. Amplitude modulation and demodulation 2. Frequency modulation and demodulation 3. Pulse Amplitude modulation and demodulation 4. Pulse width modulation and demodulation 5. Pulse position modulation and demodulation 6. Phase modulation and demodulation 10. Pulse code modulation and demodulation 11. Delta modulation and demodulation 12. Open ended experiment –A. 13. Open ended experiment –B.	75
II	1. Study of Dielectric constant and Curie Temperature of Ferroelectric Ceramics. 2. Resistivity of semiconductor by Four Probe method at different temperatures and determination of Band – gap. 3. Study of Electron Spin Resonance (ESR). 4. Hall effect Experiments (i) Hall Probe (Ge crystal – n type) (ii) Hall Probe (Ge crystal –p type) 5. Study of Magnetic Hysteresis loop using tracer. 6. Measurement of magnetoresistance of semiconductors. 7. Identification of Lattice and Determination of Lattice Constant by X-Ray Diffraction simulation. 8. Open ended experiment –A. 9. Open ended experiment –B.	75

Suggested Readings:

1. George Kennedy, Brendan Davis, Electronic Communication Systems, Srm Prasanna, McGraw Hill Education.
2. C. Kittel Introduction to Solid State Physics (Wiley, New York)
3. J. Ziman Principles Of the Theory of Solids (Cambridge University Press, Cambridge)
4. Azaroff- Introduction to Solids
5. Omar- Elementary Solid-State Physics
6. Aschroft & Mermin Solid State Physics (Reinhert & Winston, Berlin)
7. Chaikil & Lubensk Principles of Condensed Matter Physics
8. S. O. Pillai Solid State Physics (new Age International Publishers)
9. M. A. Wohab Soild State Physics (Narosa).
10. H. Ibach and H. Luth, Solid State Physics (Springer)

This course can be opted as an elective by the students of following subjects:

Suggested Continuous Evaluation Methods:

Total Marks: 50

Lab Record File (depending upon the no. of experiments performed out of the total assigned experiments): 20

marks for Viva Voce/Performance: 20

Class Interaction: 10

Course prerequisites: To study this course, a student must have basic circuit knowledge.

Suggested equivalent online courses:
https://nptel.ac.in/courses/108108112
Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Program/Class: Master of Science in Physics (Electronics)	**Year: Second**	**Semester: III**
Subject: Physics (Electronics)		
Course Code: B220908P	**Course Title:** Physics Laboratory Course -III (B)	
Course Objectives:		
The objective of the Laboratory is to provide practical exposure of communication by various technique and applications. The objective of microprocessor 8086 lab is to provide awareness of programming of 8086.		
Course outcomes:		
After completion of this course, a student will be able to: CO1: The student will be able to know about various technique of communication. CO2: The student will be able to application of various techniques in different condition. CO3: Students will become familiar with the free-electron model for metals and use the concept of Fermi energy and Fermi temperature. CO2: Students will accrue basic knowledge and practical exposure of the Solid-State physics.		
Credits: 5	**Core Compulsory**	
Max. Marks: 50+50	**Min. Passing Marks: 40**	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-10		

Group	Experiment	No. of Lab Hours
I	Communication Lab. 1. Amplitude and Frequency modulation and demodulation 2. Pulse Amplitude, Pulse Width modulation and demodulation 3. Pulse position modulation and demodulation 4. Study of TDM and FDM Scheme. 5. Pulse code modulation and demodulation 6. Delta modulation and Adaptive delta modulation. 7. Open ended experiment –A. 8. Open ended experiment –B.	75
II	1. Study of Dielectric constant and Curie Temperature of Ferroelectric Ceramics. 2. Resistivity of semiconductor by Four Probe method at different temperatures and determination of Band – gap. 3. Study of thermoluminescence of F-centres in Alkali Halide crystal (a) Experimental set-up for creating the thermoluminescence containing oven (up to 2000 C) with power supply, digital thermometer (RTD Sensor) and black box. (b) For measuring of luminescence intensity: (i). Photomultiplier tube. (ii). PMT housing with biasing circuit and connecting coaxial cables.	75

	(iii). EHT power supplHall effect Experiments 4. Measurement of magnetoresistance of semiconductors (i). Four Probe Arrangement (ii). Sample: Ge Crystal (n- type) (iii). DMR Probe stand (iv). Magneto resistance setup (v). Electromagnet (vi). Constant current power supply (vii). Digital Gaussmeter 5. Open ended experiment –A 6. Open ended experiment –B.	

Suggested Readings:

1. George Kennedy, Brendan Davis, Electronic Communication Systems, Srm Prasanna, McGraw Hill Education.
2. C. Kittel Introduction to Solid State Physics (Wiley, New York)
3. J. Ziman Principles Of the Theory of Solids (Cambridge University Press, Cambridge)
4. Azaroff- Introduction to Solids
5. Omar- Elementary Solid-State Physics
6. Aschroft & Mermin Solid State Physics (Reinhert & Winston, Berlin)
7. Chaikil & Lubensk Principles of Condensed Matter Physics
8. S. O. Pillai Solid State Physics (new Age International Publishers)
9. M. A. Wohab Soild State Physics (Narosa).
10. H. Ibach and H. Luth, Solid State Physics (Springer)

This course can be opted as an elective by the students of following subjects:

Suggested Continuous Evaluation Methods:

Total Marks: 50

Lab Record File (depending upon the no. of experiments performed out of the total assigned experiments): 20

marks for Viva Voce/Performance: 20

Class Interaction: 10

Course prerequisites: To study this course, a student must have basic circuit knowledge.

Suggested equivalent online courses:

https://nptel.ac.in/courses/108108112

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

M.Sc Physics (Electronics) Second Year Forth Semester

Program/Class: Master of Science in Physics (Electronics)	Year: Second	Semester: IV
Subject: Physics (Electronics)		
Course Code: B221001T	Course Title: Atomic and Molecular Physics	
Course Objectives:		
The objective is to study about Atomic and Molecular Physics		
Course outcomes:		
After completion of this course, a student will be able to: CO1: Students will be able to classical and quantum models of atom. CO2: They will learn different types of interactions in atom and their physical significance. CO3: They will learn importance rotational and vibrational spectra molecules. CO4: They will be able to distinguish among atomic, molecular and electronic spectra and structure of molecules.		
Credits:5	Core Compulsory	
Max. Marks: 25+75	Min. Passing Marks: 40	
Total No. of Lectures-Tutorials-Practical (in hors per week): L-T-P: 4-1-0		

Unit	Topics	No. of Lectures
I	Quantum mechanical treatment of one electron atom, fine structure of hydrogen atom. Spectra of alkali elements, singlet and triplet states of He.	18
II	Spin-orbit interaction, L-S and J-J coupling, Lande g-factor for L-S coupling, Lande interval rules, selection rules, Intensity relations, Zeeman (Normal and anomalous), Paschen back and stark effects, hyperfine structure and isotopic shift, Lamb shift.	19
III	Spectra of Diatomic Molecules Rotational Spectra (rigid rotator and non-rigid rotator model) Vibrational Spectra (harmonic and enharmonic model) Molecular Symmetric Top, Vibrating rotator Isotopic shift	20
IV	Raman Spectra (Quantum mechanical and classical approach) Electronic Spectra-vibrational structure of band system, fine structure of the band systems. Intensity distribution in band systems: Frank Condon principle	18

Suggested Readings:

1. H.E. White, Introduction to Atomic spectra
2. C.N. Banwell, Fundamental of Molecular spectroscopy, TMH.
3. G. Herzberg, Atomic spectra & Structure
4. Bransden and Joachain, Physics of Atoms and Molecule
5. J. M. Brown, Molecular spectroscopy
6. G. M. Barrow, Introduction to Molecular spectroscopy
7. P.F. Bemath, Spectra of Atoms and Molecule
8. B. P. Stranghan and S. Walker, Spectroscopy, Vol I, II and III.
9. G. K. Woodgate, Elementary atomic structure, Claredon Press.
10. M. Karplus, Atoms and Molecules, Benjamin-Cumming Pub. Co
11. J M Brown, Molecular spectroscopy, Oxford University Press .
12. Gupta and Kumar, Introduction of spectroscopy

Suggestive digital platforms web links

This course can be opted as an elective by the students of following subjects: M.Sc PHYSICS
Suggested Continuous Evaluation Methods: Total Marks: 25 House Examination/Test: 10 Marks Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks Class performance/Participation: 5 Marks
Course prerequisites: To study this course, a student must have had Physics and Maths in B.Sc.
Suggested equivalent online courses: NPTEL Lectures
Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Program/Class: Master of Science in Physics (Electronics)	**Year: Second**	**Semester: IV**
Subject: Physics (Electronics)		
Course Code: PHC- B221002T	**Course Title: Nuclear and Particle Physics**	
Course Objectives:		
The objective is to study about to different kinds of nuclear reactions tanking place in our surrounding. student will be able to understand different kind of elementary particles, interaction and their classification		
Course outcomes:		
After completion of this course, a student will be able to: CO1: They will be able to understand about nature of nuclear forces. CO2: They will know different types of Nuclear models. CO3: They will come to different kinds of nuclear reactions tanking place in our surrounding. CO4: They will be able to understand different kind of elementary particles, interaction and their classification		
Credits:5	**Core Compulsory**	
Max. Marks: 25+75	**Min. Passing Marks: 40**	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-1-0		

Unit	Topics	No. of Lectures
I	Nucleon-nucleon interactions: Semiempirical mass formula, Nature of nuclear forces, form of nucleon-nucleon potential, Deutron problem: the theory of ground state of deuteron, excited state of deuteron, n-p scattering at low energies (cross section, phase shift analysis, scattering length, n-p scattering for square well potential, effective range theory); p-p scattering at low energies (cross-section. Experiment and result) exchange forces, tensor forces, high energy N-N scattering (quantative discussion) charge independent and charge symmetries of nuclear forces.	20
II	Nuclear Models: Evidence of shell structure, single-particle shell model, its validity and limitations, Collective model: Collective vibration and collective rotation.	18
III	Nuclear reactions: alpha, beta and gamma decays and their classifications, characteristics, selection rules and nuclear reactions, fission and fusion, Bohr-Wheeler theory, nuclear chain reactions, thermonuclear reactions.	18
IV	Properties and origin of elementary particles, classification, type of interactions and conservation laws, properties of mesons, resonance particles, strange particles and strangeness quantum number, Classification of hadrons, quarks, Gell-Mann-Okubu formula	19

Suggested Readings: **Suggestive digital platforms web links**
This course can be opted as an elective by the students of following subjects: N.A ……..
Suggested Continuous Evaluation Methods: Total Marks: 25 House Examination/Test: 10 Marks Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks Class performance/Participation: 5 Marks
Course prerequisites: To study this course, a student must have had Physics and Maths in B.Sc.
Suggested equivalent online courses: ……
Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Program/Class: Master in Science in Physics (Electronics)	**Year: Second**	**Semester: IV**
Subject: Physics (Electronics)		
Course Code: B221003T	**Course Title: VLSI Design and Technology**	
Course Objectives:		
The objective is to study about a design perspective, starts from basic specifications and ends with system level blocks. The course starts with basic device understanding and then deals with complex VLSI design and circuits keeping in mind the current trend in technology.		
Course outcomes:		
After completion of this course, a student will be able to: CO1: Express the Layout of simple MOS circuit using Lambda based design rules. CO2: Design CMOS based circuit CO3: Understand chip level issues and need of testability. CO4: Concepts of modeling a digital system.		
Credits:5	**Elective**	
Max. Marks: 25+75	**Min. Passing Marks: 40**	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-1-0		

Unit	Topics	No. of Lectures
I	MOSFET static behavior, Threshold voltage and its dependence on V_{SB}, MOSFET Operation in resistive and saturation region, Channel length modulation, Velocity saturation and its impact on sub-micron devices, Sub-threshold conduction, Model for manual analysis, Equivalent resistance for MOSFET in (velocity) saturated region, Comparison of equations for PMOS and NMOS, DYNAMIC behavior, Channel capacitance in different regions of operation, junction capacitance.	18
II	CMOS Inverter: VTC of CMOS inverter: PMOS and NMOS operation in various regions including velocity saturation, Switching threshold, (W/L)p/(W/L)n ratio for setting desired VM with and without velocity saturation, Noise Margins, buffer, Rationed logic: Pseudo NMOS inverter	20

	and PMOS to NMOS ratio for performance, tri-state inverter, Resistive load inverter, Load Capacitance calculations: fan out capacitance, self-capacitance calculations: Miller effect, Propagation delay: first order analysis, analysis from a design perspective, sizing a chain of inverters for minimum delay, choosing optimum number of stages, Power, Energy and Energy Delay: Dynamic power consumption, Static power, Glitches and power dissipation due to direct path currents, power and delay trade off.	
III	CMOS LOGIC: Good 0 and Poor 0, Two and Higher input NAND and NOR, XOR, XNOR gates, Functions implementations, 2 input Multiplexer, Full Adder; Pseudo NMOS, DSVCL logic, CPL based gates, Logical effort, Electrical Effort, Branching effort, Pass-transistor logic, Transmission Gate chain, Dynamic CMOS design: Pre-charge and Evaluation, charge leakage, bootstrapping, charge sharing, DOMINO Logic. NAND and NOR based SR latch, and clocked SR Latch, CMOS D latch, MUX based Latches, clock skew, C2MOS register, TSPCR Register, Schmitt Trigger, Pipelining and NORA CMOS. CMOS Layout design rule.	**18**
IV	Introduction To IC Technology: SSI, MSI, LSI, VLSI Integrated Circuits. Crystal Growth and Wafer Preparation: Electronic Grade Silicon, Czochralski Crystal Growth, Silicon Shaping, Processing Considerations. Wafer Cleaning Technology - Basic Concepts, Wet cleaning, Dry cleaningEpitaxy: Vapor-Phase Epitaxy, Molecular Beam Epitaxy, Silicon on Insulators, Epitaxial Evaluation. Oxidation: Growth Kinetics, Thin Oxides, Oxidation Techniques and Systems, Oxides Properties. Lithography: Optical Lithography, Electron beam lithography, Photo masks, Wet Chemical Etching. Dielectric and Polysilicon Film Deposition: Deposition Processes of Polysilicon, Silicon Dioxide, Silicon Nitride. Diffusion: Models of diffusion in solids, Fick's 1-Dimensional diffusion equation, Diffusion of Impurities in Silicon and Silicon Dioxide, Diffusion Equations, Diffusion Profiles, Diffusion Furnace, Solid, Liquid and Gaseous Sources, Ion-Implantation: Ion-Implantation Technique, Range Theory, Implantation Equipment. Metallization: Metallization Application, Metallization Choices, Physical Vapor Deposition, Vacuum Deposition, Sputtering Apparatus. Packaging of VLSI devices: Package Types, Packaging Design Consideration, VLSI Assembly Technologies, Package Fabrication Technologies, CMOS fabrication steps.	**19**

Suggested Readings:

1. Kang: CMOS Digital ICs, McGraw-Hill Science/Engineering/Math; 3 edition
2. Jan M Rabaey: Digital Integrated Circuits, Prentice Hall; 2 edition (January 3, 2003).
3. Neil H.E. Weste and Kamran Eshraghian, Principles of CMOS VLSI Design, Pearson Education ASIA, 2nd edition, 2000.
4. John P.Uyemura "Introduction to VLSI Circuits and Systems", John Wiley & Sons, Inc.,
5. Eugene D.Fabricius, Introduction to VLSI Design McGraw Hill International Editions
6. Pucknell, "Basic VLSI Design", Prentice Hall of India Publication, 1995.
7. S. M. Sze, "VLSI Technology", McGraw Hill Publication, 2003
8. S.K. Ghandhi, "VLSI Fabrication Principles", Willy-India Pvt. Ltd, 2008

This course can be opted as an elective by the students of following subjects: M.Sc. Electronics

Suggested Continuous Evaluation Methods:

Total Marks: 25

House Examination/Test: 10 Marks

Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks

Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have had the basic knowledge of semiconductor devices and digital design.

Suggested equivalent online courses: https://onlinecourses.nptel.ac.in/noc21_ee09/preview https://www.coursera.org/certificates/vlsi-design-iitr
Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Program/Class: Master of Science in Physics (Electronics)	Year: Second	Semester: IV
Subject: Physics (Electronics)		
Course Code: B221004T	Course Title: Optoelectronics and Optical Communication	

Course Objectives

The objective of this course is to introduce the student to the Optical sources, detectors understanding of basics of fiber optical communication. This includes the properties of optical fibers and how are they used to establish optical links for communication systems.

Course outcomes:

At the end of this course, students will be able to

1. Understand fundamental properties of light and operation principles of basic optical Components.
2. Understand the operating principles and characteristics of optical sources.
3. Understand and compare operating principles, characteristics of optical detectors.
4. Understand fundamentals theories, basic principles and components of optical fiber communication system.

Credits: 5	Elective
Max. Marks: 25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-1-0

Unit	Topics	No. of Lectures
I	Light Emitting Diodes (LEDs): Structures, light source materials, Quantum Efficiency on LED Power Modulation of a LED, Lasers, Theory of Stimulated emission, Principle of laser action, types of lasers, Laser diodes, characteristics of semiconductor lasers and LEDs.	18
II	Optical detector principle, Characteristics of photo detector-absorption coefficient, detector, characteristics, Quantum efficiency, responsivity, P-N junction-photo diode, P-I-N photodiode, avalanche photodiode, Noise in Photo detectors, Photo conductors.	18
III	Different generations of optical fiber communication systems, Optical fiber structure, Propagation of light- total internal reflection, acceptance angle and numerical aperture, Step-index, Graded-index, Single and Multimode fibers.	20
IV	Transmission characteristics of optical fibers-Signal degradation in optical fibers; Attenuation, Dispersion and pulse broadening in different types of optical fibers, fiber splicing, fiber connectors, connection losses, fiber couplers.	19

Suggested Readings:

1. John M.Senior, Optical fiber Communications; Principles and practice by, 3rd Edition, 2010, Pearson education.

2. Gerd Keiser, Optical Fiber Communication; 5th Edition, 2013, Tata McGraw Hills.
3. Djafar K Mynbaev & Lowell L Scheiner; Fiber Optic Communications Technology by, 3rd Edition, 2008, Pearson Education.
4. J. Gowar, Optical Communication systems, 2nd Edition, 2001, Prentice-Hall of India.
5. Govind P. Agrawal; Fiber-Optic Communication Systems by, 3rd Edition, 2007, Wiley India.
6. Ghatak and Thyagrajan, Optical Electronics, Cambridge University Press

This course can be opted as an elective by the students of following subjects

Physics/Computer Science/ Mathematics/Statistics

Suggested Continuous Evaluation Methods:

Total Marks: 25

Internal Test: 10 Marks

Home Assignment/Presentation /Project / Research Orientation/ Term Papers/Seminar: 10 Marks

Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have had the subject Physics/Electronics/Computer Science/ Mathematics/Statistics in class certificate/diploma.

Suggested equivalent online courses:

1. MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning (NPTEL), https://www.youtube.com/user/nptelhrd
3. Uttar Pradesh Higher Education Digital Library, http://heecontent.upsdc.gov.in/SearchContent.aspx
8. SwayamPrabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program

Further Suggestions: .....

Program/Class: Master of Science in Physics (Electronics)ss	**Year: Second**	**Semester: IV**
Subject: Physics (Electronics)		
Course Code: B221005P	**Course Title:** Major Research Project/ Dissertation	

Course Objectives:

The objective of this course is to apprise the student with various techniques and areas of modern-day research in Physical Sciences specifically in Physics.

Course outcomes:

After completion of the course, a student will be able to:
CO 1:Prepare synopsis of a defined research problem.
CO 2:Perform the bench work.
CO 3: Prepare the research report and its oral presentations.
CO4:Get exposure of vigorous laboratory training which will help students to boost their research carrier.

Credits: 10	**Core Compulsory**
Max. Marks: 50+50	**Min. Passing Marks:40**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-20

Suggested Continuous Evaluation Methods:
(Assessment is done by Guide)

Total Marks: 50
Content of Report: 20
Continuous Assessment by Guide: 20
Interaction with Guide: 10

17/12/2021