FACULTY OF SCIENCE & TECHNOLOGY

KAVAYITRI BAHINABAI CHAUDHARI NORTH MAHARASHTRA UNIVERSITY, JALGAON

'A' Grade
NAAC Re-Accredited
(3rd Cycle)

SYLLABUS
FOR
T. Y. B. Sc. (PHYSICS)

(AS PER CHOICE BASED CREDIT SYSTEM PATTERN OF UGC)

(With effect from June - 2020)

Preamble

The University Grants Commission (UGC) has initiated several measures to bring equity, efficiency and excellence in the Higher Education System of country. The important measures taken to enhance academic standards and quality in higher education include innovation and improvements in curriculum, teaching-learning process and examination and evaluation systems.

In that context in the last decade, North Maharashtra University, Jalgaon has taken several initiatives to upgrade and enhance the academic excellence, examination reforms and developing the skilled minds and skilled hands. As per the directions of UGC, from last year our KBC North Maharashtra University, Jalgaon has implemented the Choice Based Credit (CBCS) pattern to undergraduate programs run by various colleges affiliated to NMU, Jalgaon. As per the directions given by the Honorable Vice Chancellor, Pro-Vice Chancellor and Dean of the Faculty of Science and Technology of our university, one day workshop was organized for syllabus framing. The teachers of the affiliated colleges and university department were participated in the workshop of re-structuring the syllabi of T.Y.B.Sc. (Physics) as per the CBCS pattern and it has been finalized during the workshop and the same will be effectively implemented from the academic year 2020-21.

The main objective of the re-structuring the syllabus of T.Y.B.Sc. (Physics) is to create skilled minds and therefore expectation is to equip the students with the knowledge and understanding of concepts of physics rather than the ability to remember facts so that they may have a reasonable comprehensive and complete grasp of principles of physics. It is expected that the students should study physics with keen interest, develop their experimental skill and problem solving ability. The students should communicate their knowledge of Physics to the Society, to make them to understand physics around us. The students should use their knowledge of Physics for betterment of our Society, our nation and the World.

Board of Studies (Physics),

North Maharashtra University, Jalgaon

OBJECTIVES

1. To provide education in physics of the highest quality at the undergraduate level and generate graduates of the caliber sought by industries and public service as well as academic teachers and researchers of the future.
2. To acquire deep knowledge in fundamental aspects of Physics and basic knowledge in the specialized thrust areas like Thermodynamics, Basic electronics, Waves, Sound, Optics, LASERS, Energy harvesting and electrical circuit skills.
3. To develop ability among the students to identify, remember and grasp the meaning of basic facts, concepts and principles of Physics.
4. To develop observational skills, confidence in using scientific equipment and relate the knowledge of scientific concepts to quantitative and physical measurement.
5. Acquire knowledge, skills, working methods and ways of expression which will reflect on all round development of the students' attitudes towards scientific thinking and its applications.
6. To develop attitudes such as concern for accuracy and precision, objectivity, and Enquiry.
7. The overall aim is to provide comprehensive knowledge and understanding in the relevant fields and enable students to pursue the physics subject at an advanced level later and to attract outstanding students from all back grounds.

BOS (PHYSICS)-Faculty of Science & Technology

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon

Class: **T. Y. B. Sc.** Subject: **Physics**

Choice Base Credit System (With effect from June 2020)

The Board of Studies in Physics has unanimously accepted the revised syllabus (as per CBCS pattern) prepared by different committees, discussed and finalized in the **Online Workshop on Curriculum Development in Physics at T. Y. B. Sc.** held on15th and 16th May 2020.

The titles of the papers for T.Y.B.Sc. (Physics) are as given below:

Sem	Course type	Course code	Course title	Credits	Total hrs /week	Total teaching periods	Total marks	
							CA	UA
V	Discipline specific Course (DSC)	PHY 501	Mathematical Physics	3	3	45	40	60
		PHY502	Solid State Physics	3	3	45	40	60
		PHY 503	Atomic and molecular physics	3	3	45	30	60
		PHY 504(A) Or PHY 504(B)	Electronics-II Or Instrumentation -II	3	3	45	40	60
	Skill Enhancement course (SEC)	PHY 505	Solar Energy and applications	3	3	45	40	60
	DSE Elective course (Any one)	PHY 506(A) PHY 506(B) PHY 506(C) PHY 506(D) PHY 506 (E)	Technical Electronics- I or Refrigeration and Air conditioning- I or Vacuum Technology-I or Microprocessor-I or Programming in C++ I	3	3	45	40	60
	DSC CORE Practicals	PHY 507	Physics Practical I	2	4 (per batch)	60	40	60
		PHY 508	Physics Practical II	2	4 (per batch)	60	40	60
		PHY 509	Physics Practical III or Project	2	4 (per batch)	60	40	60
	Non credit audit course (Any one)	AC 501(A)	NCC	No credit	2	30	100	
		AC 501(B)	NSS					
		AC 501 (C)	Sports					
			Total credit	24				

Sem	Course type	Course code	Course title	Credits	Total hrs /week	Total teaching periods	Total marks	
							CA	UA
VI	Discipline specific Course (DSC)	PHY 601	Quantum mechanics	3	3	45	40	60
		PHY602	Material Science	3	3	45	40	60
		PHY 603	Nuclear Physics	3	3	45	30	60
		PHY 604	Modern Physics	3	3	45	40	60
	Skill Enhancement course (SEC)	PHY 605	Basic Instrumentation Skills	3	3	45	40	60
	DSE Elective course (Any one)	PHY 606 (A) PHY 606 (B) PHY 606 (C) PHY 606 (D) PHY 606 (E)	Technical Electronics- I or Refrigeration and Air conditioning- II or Vacuum Technology-II or Microprocessor-I or Programming in C++ II	3	3	45	40	60
	DSC CORE Practicals	PHY 607	Physics Practical I	2	4 (per batch)	60	40	60
		PHY 608	Physics Practical II	2	4 (per batch)	60	40	60
		PHY 609	Physics Practical III or Project	2	4 (per batch)	60	40	60
	Non credit audit course (Any one)	AC 601(A)	Soft skill	No credit	2	30	100	
		AC 601(B)	Yoga					
		AC 601(C)	Practicing Cleanliness					
			Total credit	24				

Note: The industrial/study tour is compulsory for students of T. Y. B. Sc. (Physics).

Semester V: (DSC): Physics paper I
PHY 501: Mathematical physics
(Credits: 03) :(45 Lectures 60 Marks)

Course description:
This course is aimed at introducing the concepts of Mathematical physics to Under Graduate students.

Course objectives:
1. To impart knowledge of basic concepts in Mathematical physics.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:
Learner will be able to ….
1. Apply the concept and knowledge of Mathematical physics to understand and solve real life problems.
2. Understanding of the course will create scientific temperament.

Unit 1: Vector Analysis
Gauss divergence theorem, Stokes' theorem, Green's first and second theorem, Green's theorem in the plane. (Statements, proofs and problems) **(5P, 6M)**

Unit 2: Differential Equation
Introduction to Cartesian (X, Y, Z), Spherical polar (r, θ, φ) and Cylindrical (ρ, φ, z) co-ordinate systems and their transformation equations, Degree, order, linearity and homogeneity of partial differential equation, Method of separation of variables in Cartesian, Spherical polar and Cylindrical co-ordinate system (Wave equation and Laplace's equation), Singular points, Singular points of Legendre and Hermite differential equation, Statement of Fuche's theorem, Frobenius method of series solution, series solution of linear simple harmonic oscillator and Legendre differential equation **(11P, 16M)**

Unit 3: Special Functions
Generating functions for Legendre Polynomial $P_n(x)$, Hermite polynomial $H_n(x)$,and Bessel functions of first kind $J_n(x)$. Proof of following properties

1) $(n+1)\,P_{n+1}(x) = (2n+1)\,x\,P_n(x) - n\,P_{n-1}(x)$. 2) $P_n(x) = P'_{n+1}(x) - 2x\,P'_n(x) + P'_{n-1}(x)$.
3) $H_{n+1}(x) = 2\,x\,H_n(x) - 2n\,H_{n-1}(x)$. 4) $H'_n(x) = 2n\,H_{n-1}(x)$.
5) $J_{n+1}(x) + J_{n-1}(x) = 2n / x\,J_n(x)$. 6) $J_{n-1}(x) - J_{n+1}(x) = 2\,J'_n(x)$. **(8P, 10M)**

Unit 4: Complex Analysis
Complex numbers and their graphical representation, Argand diagram, Conjugate of a complex number, Basic mathematical operations with complex numbers, Euler's formula, De-Moivre's theorem, Roots of complex numbers, Functions of complex variables, Analyticity and Cauchy - Riemann conditions, Singular functions, Examples. **(10P, 14M)**

Unit 5: Special Theory of Relativity
Newtonian relativity, absolute space, Galilean transformations, Michelson-Morley experiment, postulates of special theory of relativity, Lorent'z transformation equations, Length contraction, time dilation, relativity of simultaneity, variation of mass with velocity, addition of velocities, mass-energy relation, energy momentum relation. **(11P, 14M)**

(Total: 45 Periods, 60 Marks)

References:

1. Mathematical Physics: B.S. Rajput, Pragati Prakashan (19th Edition, 2007).
2. Mathematical Physics: B. D. Gupta.
3. Mathematical Methods for Physics: G. Arfken, Hens Weber (4th Edition, 1995).
4. Mathematical Methods in the Physical Science: Mary L. Boas.
5. Vector Analysis: Murray R. Spiegal, Schaum's series.
6. Introduction to Special theory of Relativity – Robert Resnick, Wiley Eastern Ltd.
7. Mathematical physics: Ghatak
8. Complex variables and applications: J. W. Brown

Semester V: (DSC): Physics paper II

PHY 502: Solid State physics

(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Solid state Physics to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Solid state Physics.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept and use of knowledge of Solid state Physics understand and solve the real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: The Crystal Structure

Classification of solids, Lattice, Basis & crystal structure, translational vector, Unit cell, Primitive unit cell, symmetry operations, Types of lattices (2D & 3D), Miller indices, Interplaner spacing, Number of atoms per unit cell, co- ordination number, atomic radius and packing fraction for SC, BCC and FCC structures, Study of CsCl, NaCl and ZnS structures, Concept of reciprocal lattice and its properties with proofs. **(10P, 14M)**

Unit 2: X-Ray Diffraction

Crystal as a grating for X-rays, Bragg's diffraction condition in direct lattice and reciprocal lattice, Ewald's construction, X-ray diffraction methods: Laue method, Rotating crystal method and Powder method, Analysis of cubic crystal by powder method, Brillouin zones (1D & 2D). **(08P, 10M)**

Unit 3: Cohesive energy and Bonding in solids

Cohesive energy and formation of molecules, Definition of dissociation energy of molecule, Types of bonding, Ionic bond, Covalent bond, Molecular bond, Metallic bond and Hydrogen bond, Madelung energy, Madelung constant for one dimensional ionic crystal. **(09P, 12M)**

Unit 4: Lattice vibrations and Thermal Properties

Lattice heat capacity, Classical theory of specific heat, Einstein's theory of specific heat, Vibrational modes in one dimension monoatomic lattice, Debye's model of specific heat of solids, Limitations of Debye model. **(09P, 12M)**

Unit 5: Free electron theory of metals and Band theory of solids

Drude-Lorentz classical theory, Sommerfield's quantum theory: Free electron gas in 1-D and 3-D, Fermi level and fermi energy, Density of states, Formation of Energy band, Distinction between metals, semiconductors and insulators, Hall Effect, Hall co-efficient and mobility. **(09P, 12M)**

(Total: 45 Periods, 60 Marks)

References:

1. Introduction to Solid State Physics: Charles Kittle.
2. Solid State Physics: A.J. Dekkar
3. Solid state Physics: R. L. Singhal
4. Solid State Physics: S.L. Gupta, V. Kumar.
5. Solid State Physics: S.L. Kakani, C. Hemrajan
6. Solid State Physics: C.M. Kachhava
7. Solid State Physics: R.L.Singhal, Kedar Nath, Ram Nath & Co.
8. Fundamentals of Solid State Physics: B.S. Saxena, R.C. Gupta, P.N. Saxena, Pragati Prakashan, Meerut
9. Concepts of Solid State Physics: J.N. Mandal, Pragati Prakashan, Meerut.
10. Solid State Physics: R. K. Puri and V. K. Babbar
11. Solid State Physics, H.Ibach and H Kutha, Springer (Online available book)

Semester V: (DSC): Physics paper III

PHY 503: Atomic and Molecular physics

(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Atomic and Molecular Physics to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Atomic and Molecular Physics.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept and knowledge of Atomic and Molecular Physics to understand and solve the real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Vector Atom Model

Introduction, Quantum numbers, Physical interpretation of quantum numbers, Electron spin, Larmor precession of electron orbit, Pauli's exclusion principle, Definition of L-S coupling and j-j coupling, Spin-Orbit interaction, Spectral terms, Selection rules, Spectra of single valence electron system (sodium), Problems. **(08P, 11M)**

Unit 2: Two Valence Electron System

Introduction, Spin-spin and orbit-orbit interaction, L-S and j-j coupling schemes, Singlet triplet separations, s-p and p-d configuration in L-S coupling and j-j coupling, Lande Interval rule, Spectra of Helium, Problems. (**10P, 13M)**

Unit 3: Zeeman & Paschen Back effect

Introduction, Magnetic dipole moment, , Zeeman Effect: Experimental set up, Normal and Anomalous Zeeman Effect for single valence electron system, Lande 'g' factor for two valence electron system (L-S and j-j coupling), Paschen Back effect for single valence electron system, Problems. **(10P, 13M)**

Unit 4: X-ray spectra

Origin and nature of X-ray, Characteristic X-ray spectra, Moseley's law and its importance, Energy level of Cadmium, Regular and Irregular doublets and their laws, Applications of X-ray (List only) **(07P, 10M)**

Unit 5: Molecular spectra

Introduction, Regions of electromagnetic spectrum, Types of molecular spectra, Rotational spectra of rigid diatomic molecule, Rotational energy levels of rigid diatomic molecule, Vibration of atoms in a diatomic molecule, Vibrational energy levels for Diatomic molecule, Raman spectra – Experimental set up, Explanation of Stoke's and Anti-stoke's lines, Applications of Raman effect. **(10 P, 13M)**

(Total: 45 Periods, 60 Marks)

References:

1. Introduction to Atomic Spectra: H.E. White, McGraw Book Company, Inc.
2. Fundamental of Molecular spectroscopy: C.N. Banwell, Tata McGraw hill, 3rd edition.
3. Spectra of Diatomic Molecules: G Hertzberg, D Van Nastrand compony, Inc., NewYork.
4. Perspectives of Modern Physics: Arthur Beiser, McGraw Hill Kogakusha Ltd, Tokyo.
5. Atomic spectra and Molecular spectra: Raj kumar, Kedarnath Ramnath Prakashan.
6. Introductory Raman spectroscopy: Elsevier publication.
7. Theoretical Atomic physics (Fourth Edition): Harald Friedrich.
8. Physics of Atoms and Molecules(Second edition):B. H. Bransden & C. J. Joachain.
9. The fundamentals of Atomic and Molecular Physics: Robert L. Brooks.

Semester V: (DSC): Physics paper IV
PHY 504(A): Electronics-II
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Electronics and Digital Electronics to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Electronics and Digital Electronics.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept and use of knowledge of Electronics and Digital Electronics to real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Transistor biasing and Transistor amplifiers

Need of biasing, Different methods of biasing (only list), Voltage Divider bias method in detail, Single stage RC coupled Common emitter amplifier: Working, voltage gain, frequency response and bandwidth, Definition of Voltage amplifier and Power amplifier, Class A, B , C and AB power amplifiers (only load line diagram and explanation) and application list of each type. **(09P, 11M)**

Unit 2: Transistorised Sinusoidal Oscillators

Types of feedbacks, Barkhausen Criterion, Oscillatory circuit (tank circuit), Types of Oscillators (List only), Hartley oscillator, RC phase shift Oscillator **(04P, 07M)**

Unit 3: Semiconductor switching devices

FET: Types (n-channel and p-channel), Constructional detail, electronic symbol, working principle and I-V Characteristics, FET parameters, Introduction to MOSFET, Applications: FET as a VVR, FET as an amplifier.

UJT: Constructional detail, Equivalent circuit, symbol, working principle and I-V Characteristics, Applications: UJT as a switch, UJT as a relaxation oscillator

SCR: Constructional detail, symbol, Equivalent circuit of SCR, working principle and I-V Characteristics, Transistor analogy and its working, Important terms (break over voltage, holding current, forward current rating), Applications: SCR as a switch, Controlled rectification using SCR. **(09P, 12M)**

Unit 4: Digital Electronics

A) Flip-flops: Logic circuit, truth table, working and symbols of R-S Flip Flop, J-K Flip Flop. **(06 P, 08M)**

B) Counters: Types of counters (Asynchronous and Synchronous), 3 bit Asynchronous up counter (Serial counter), 3 bit Asynchronous down counter, 3-bit Asynchronous Up-down counter, 3 bit Synchronous up counter (Parallel counter), modulus of counter, mod-3 counter, mod-5 counter, and mod 10. **(07P, 10M)**

C) Data Processing circuits:

Multiplexer (2 to 1 & 4 to 1 line), De-multiplexer (1 to 2 & 1 to 4 line), Decoder (1 to 2 & 1 to 4 line, BCD to decimal decoder), Encoder (Decimal to BCD encoder). **(05P, 6M)**

D) Timer: Functional block diagram of IC-555 (Timer), Pin configuration, Astable, Monostable and Bistable multivibrator using IC 555, Application: Square wave Generator **(05P, 6M)**

(Total: 45 Periods, 60 Marks)

References

1. Principles of Electronics – V. K. Mehta, S. Chand Publications, New Delhi.
2. Basic Electronics: B. L. Theraja, S. Chand Publications, New Delhi.
3. Digital Principles and Applications – Malvino and Leach, McGraw-Hill Publication.
4. Electronic Principles – A. P. Malvino, Mc-Graw-Hill Publishing House.
5. Modern Digital Electronics – R. P. Jain, Tata McGraw-Hill Pvt. Ltd., New Delhi.
6. Integrated Circuits - K. R. Botkar, Khanna Publishers (2004).
7. Electronic fundamentals and applications – J. D. Ryder, Prentice Hall 4th Edition.
8. Electronic Devices and Circuits – Allen Mottershead, Good year publishing Company.

Semester V: (DSC): Physics paper IV
PHY 504(B): Instrumentation-II
(Credits: 03) :(45 Lectures 60 Marks)

Course description:

This course is aimed at introducing the fundamentals of Instrumentation to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Instrumentation.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept and use of knowledge of Instrumentation to understand and to solve real life problems.
2. Understanding of the course will create scientific temperament.

Unit 1: Introduction to Instrumentation

Definitions: Resolution, Threshold, Range and span, Hysteresis, Dead band, Backlash, Drift, Impedance loading and matching. Functional elements of measurement system (Brief description), Classification of instruments- Deflection and Null type, Manually operated and automatic type, Analog and Digital types, Self-generating and power-operated types, Contacting and Non-contacting types. Dynamic Characteristics of Instruments: Dynamic response of zero order, First order, & Second order instrument.**(10P, 12M)**

Unit 2: Transducers

Introduction, Analog transducers- Electromechanical type, Potentiometric Resistance-type, Inductive type, Self-generating type, Non-self generating type, Capacitance type, Piezo-electric type, Resistance-strain gauges, Opto-electric transducer, Digital transducers: Frequency domain transducers, Digital encoders, Optical encoders, Shaft encoder. **(11P, 16M)**

Unit 3: Data Acquisition Systems

Introduction, Data converters, Digital to analog converters- Binary weighted and R-2R ladder. Analog to digital converters - Successive approximation method, Single and dual slopeintegration type ADC. Data transmission elements-Electrical-type, Pneumatic-type, Positiontype,Radio-Frequency type. **(12P, 16M)**

Unit 4: Data Presentation Systems

Indicating elements- Digital voltmeters, Digital Multimeter, CRO (Analog & Digital),Recorders- Strip chart, X-Y recorder,Digital data recording (CD Recording system).Display elements- Classification of displays, Display devices- LED, LCD, 7-segment display, Dot matrix display, Electro luminescent display. **(12P, 16M)**

(Total: 45 Periods, 60 Marks)

References:

1. Instrumentation: Measurement and analysis - Nakra and Chaudhary
2. Electronic Instrumentation – H.S. Kalsi
3. Electronic Instrumentation and Measurement Techniques - Helfrick and Cooper
4. Instrumentation: Device and system - Rangan, Mani, Sharma
5. Transducers & Instrumentation- D.V.S. Murty, PHI Publication.
6. Electrical and Electronic Measurement & Instrumentation - A.K. Sawhney
7. Transducers and display systems: B. S. Sonde, Tata McGraw-Hill Publishing Company.
8. Data Converters– B. S. Sonde, Tata McGraw-Hill Publishing Company Limited.
9. Audio and Video Engineering System: R.G. Gupta, Tata McGraw-Hill Publishing Company.

Semester V: (SEC): Physics paper V

PHY 505: Solar energy and applications

(Credits: 03) :(45 Lectures 60 Marks)

Course description:

The aim of this course is not just to impart theoretical knowledge solar energy fundamentals and applications to the students but to provide them with exposure and hands-on learning wherever possible.

Course objectives:

1. To impart knowledge of basic concepts of clean, safe and affordable energy.
2. To provide the knowledge about variety of solar energy applications.
3. To provide the knowledge and methodology of conversion of solar energy into heat& electricity.

Course outcome:

Learner will be able to ….

1. Apply the concept of use of knowledge of energy resources, solar radiations and conversion to real life problem.
2. Understanding of the course will create scientific temperament.
3. To impart knowledge of basic concepts of solar cell fundamentals.
4. To provide the knowledge and methodology of conversion of solar energy into electricity.

Unit 1: Solar Radiation:

The Sun, structure of the sun, solar constant, spectral distribution of extra-terrestrial radiation, Solar radiation at the earth's surface (terrestrial radiation), solar time and equation of time, Definitions: air mass, beam radiation, diffuse radiation, global radiation, irradiance, solar insolation. Solar radiation geometry, Empirical equation (derivation not expected) for Monthly Average: 1) Daily global radiation, 2) Daily diffuse radiation, 3) Hourly global radiation, 4) Hourly diffuse radiation. Solar radiation on tilted surfaces. Instruments for measuring solar radiation: Pyranometer, Pyrheliometer. **(05P, 08M)**

Unit 2: Solar Collectors:

Flat plate collector: Types (Liquid flat-plate type, Evacuated Tube collector type, flat-plate with Al-insulator, Polymer solar collector), materials for collectors (Absorber plate, Insulation and Cover plate),Efficiency of flat plate collector, Loss coefficients and Heat transfer, Heat Removal Factor, Improvement in efficiency.

Solar Concentrating Collectors: Flat plate collector with reflector, Cylindrical parabolic collector, Thermal analysis, Performance analysis. **(10P, 12M)**

Unit 3: Solar Photovoltaics:

A P-N junction, Energy level diagram of semiconductors, Fermi level in doped semiconductors, Photovoltaic principals, Materials for Solar cell, Single crystal silicon cell: Principle, construction, working, equivalent circuit, I-V characteristics of solar cell, Fill factor, Power-voltage characteristics of solar cell, Maximum conversion efficiency, Actual conversion efficiency, Limitations to cell efficiency, Multicrystalline silicon cell, Thin Film Solar Cell, Short circuit current, Open circuit voltage, Maximizing the performance, Cell size. **(10P, 12M)**

Unit 4: Solar Thermal Applications:

Solar water heater: Direct natural circulation type, Direct forced circulation type, Design consideration of solar water heater, Series and Parallel Arrays, Solar drying of food (Direct type and Indirect mode type),Solar cooling and refrigeration, Solar thermal power generation, Solar furnace (Direct incident type). **(10P, 14M)**

Unit 5: Solar PV Applications:

PV Systems: Classification, Basic Photovoltaic power system, Stand-alone PV system, Solar Cell Modules (Solar PV arrays), Series and Parallel combination of PV Modules, Grid-connected system, Solar power satellite, Power conditioning and control. Design of PV System: Array size and Battery size.

Energy storage: electro chemical batteries, large capacity approaches.

PV Applications: Industrial applications, Social applications, Consumer applications. **(10P, 14M)**

(Total: 45 Periods, 60 Marks)

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Demonstrations and Experiments:

(Note: Total 4 experiments are expected to be taken in the LAB by the teacher of this course while teaching the course.)

A) Solar Thermal Applications (Any two of the following)

1. Study of Solar Box Cooker
2. Study of Concentrating type Solar Cooker.
3. Solar Energy Measurements using Pyranometer.
4. Solar Energy Measurements using Pyrheliometer.
5. Study of Solar still for Water distillation.
6. Study of Solar Dryer: Hot air collector.

B) Solar PV Applications (Any two of the following)

1. Measurement of V_{OC} and I_{SC} of a Solar cell.
2. Determination of I-V & P-V Characteristics of a Solar cell.
3. Determination of I-V & P-V Characteristics of Series and Parallel combination of PV Modules.
4. Effect of Shading on Solar PV Module Output Power.
5. Study of Power versus load characteristics of Solar Photovoltaic panel
6. Study of Solar Lantern/ Street light

Note: For Solar energy modelling techniques, the software used for simulation in solar energy field, comparative review of software for solar photovoltaics, solar thermal systems and buildings. Use of software such as TRNSYS, PVSYST, PVSOL, SAM, SOLTRACE, HOMER, Meteonorm etc is advised.

References:

1. Solar Energy- S. P. Sukhatme and J K Nayak, Fourth Edition, Tata Mac Graw Hill Co. Ltd.
2. Solar Energy Fundamentals and Applications – H P Garg and J Prakash, Tata McGraw Hill Co. Ltd.
3. Solar Energy Utilisation – G D Rai, Khanna Publishers.
4. Solar Engineering and Thermal Processes – Duffie J. and W. Beckman (1991), John Willey and Sons Inc.
5. Solar Power Engineering – Magal B. S. (1990), Tata Mac Graw Hill Co. Ltd.
6. Renewable Energy Sources and Conversion Technology – Bansal N. K., M. K. M. Meliss (1990), Tata Mac Graw Hill Co. Ltd.

Semester V: (DSE): Physics paper VI
PHY 506(A): Technical Electronics-I
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Technical Electronics to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Technical Electronics.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept of use of knowledge of Technical Electronics to real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Components and devices

Resistors, Capacitors, Inductors (Types, construction and specification), Identification of resistor and capacitor values, Transformers: Types, (Single phase power transformer, auto transformer, isolation, AF, RF, IF), Switches, Types of switches, Relay: Types (list only), Electromagnetic relay: Principle, Construction and Working. [Ref. 1 to 6] **(06P, 09M)**

Unit 2: Optoelectronic Devices

LED (Construction, Working & Applications), Seven Segment Display, Liquid Crystal Display (LCD), Photodiode (Construction, working, characteristics & applications), Introduction to phototransistor. [Ref. 2 to 5, 8] **(05P, 08M)**

Unit 3: Printed Circuit Board

Idea of PCB, advantages, copper clad, Etching processes, Different steps for making PCB, Precautions while making PCB, Principle of Photolithography (For PCB).[Ref.2,3 & 4] **(06P, 7M)**

Unit 4: DC Power Supplies

Block diagram of unregulated and regulated power Supply, their merits and demerits, Series regulated power supply, Voltage regulation (Load and Line). Study of Monolithic voltage regulators: Precision voltage regulator (IC 723), Three-terminal general purpose regulators ICs- 78xx and 79xx.[Ref 1 to 3, 15] **(07P, 10M)**

Unit 5: Operational amplifier and its applications

Introduction to differential amplifier, Block diagram of Opamp, Schematic symbol and Pin diagram of IC 741, Important terms of OPAMP such as input impedance, output impedance, input offset voltage, open loop voltage gain, input bias current, slew rate. Ideal and practical parameters of Op-Amp, Concept of virtual ground, inverting and non-inverting amplifier with gain expressions, off-set null, Applications: Adder, Subtractor, Integrator, Differentiator, Comparator. [Ref 2, 3, 13,14] **(12 P, 14M)**

Unit 6: Data Converters

D to A Converters: Resistive divider network, Binary ladder network. A to D Converters: Successive approximation type, Single slope, Dual slope, Voltage to Time, Voltage to Frequency. [Ref. 7 to 12] **(09P, 12M)**

(Total: 45 Periods, 60 Marks)

References:

1. Principles of Electronics – V. K. Mehta, S. Chand Publications, New Delhi.
2. Basic Electronics (Solid State): B.L. Thereja, Publisher:S. Chand &Company, New Delhi.
3. Basic Electronics: B. Grob, Publisher: McGraw Hill Book Co. New York,
4. A Textbook of Applied Electronics – R S Sedha, Publisher: S Chand & Company, New Delhi.
5. Electronic Instrumentation: H.S. Kalsi, Tata McGraw-Hill Publishing Company Limited,New Delhi.

6. Electronic components and Materials-Principles, Manufacture and Maintenance: S. M. Dhir, Tata McGraw-Hill Publishing Company Limited, New Delhi.
7. Measurement and Instrumentation Principles: Alan S. Morris., Publisher: Butterworth-Heinemann.
8. Transducers and display systems: B. S. Sonde, Tata McGraw-Hill Publishing Company Limited, New Delhi.
9. Digital Principles and Applications: A.P. Malvino and D. P. Leach. Tata McGraw-Hill Publishing Company Limited, New Delhi.
10. Data Converters–: B.S. Sonde, Tata McGraw-Hill Publishing Company Limited, New Delhi.
11. Modern Electronic Instruments and Measurement techniques: Albert D. Helfrick, Willam D. Cooper, Prentice Hall India Pvt. Ltd, New Delhi.
12. A course in Electrical and Electronic Measurements and Instruments: A. K. Sawhney, Dhanpat Rai and Sons.
13. Op-Amps & Linear Integrated Circuits - R. A. Gaikwad, Publisher: Pearson.
14. Operational Amplifier - G. B. Clayton
15. Integrated Circuits - K. R. Botkar, Khanna Publishers (2004).
16. Optoelctronics: J. D. Ryder
17. Power supplies: B. S. Sonde

Semester V: (DSE): Physics paper VI

PHY 506(B): Refrigeration and Air conditioning-I

(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Refrigeration and Air conditioning to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Refrigeration and Air conditioning.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept and use of knowledge of Refrigeration and Air conditioning to understand and solve the real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Heat Transfer:

Introduction, Conduction through slab, pipe, hollow sphere, Convection, Heat transfer by convection, Expression for heat transfer coefficient ,combined conduction and convection heat transfer, Fins and their applications. (Ref. 1: Chapter -15) **(6L, 10M)**

Unit 2: Air Refrigeration system:

Introduction, Reversed Carnot cycle and as most efficient refrigerator, C.O.P. and its dependence on source and sink temperature, Bell-Coleman air refrigeration system, Advantages and disadvantages of air refrigeration system. (Ref. 1: Chapter - 3) **(7L, 10M)**

Unit 3: Vapour Refrigeration system:

i) **Simple Vapour Compression Refrigeration system**:

Vapour compression refrigerator, Construction of various lines on T–S chart, P- H diagram for vapour compression refrigeration, Analysis of vapour compression system Advantages and disadvantages of vapour compression refrigeration over air refrigeration system. (Ref.1: Chapter-4)

ii) **Absorption Refrigeration system:**

Introduction, Simple absorption system, Practical ammonia absorption system, C.O.P. of the absorption refrigeration system, Domestic Electrolux refrigerator, Advantages and disadvantages of absorption refrigeration over compression refrigeration system. (Ref. 1: Chapter -6) **(14L, 16M)**

Unit 4: Refrigerants:

Classification of refrigerants: primary and secondary refrigerants, Desirable thermodynamic, safe working and physical properties of refrigerants, important refrigerants, refrigerant nomenclature, selection of refrigerant. (Ref.1: Chapter -11) **(06L, 8M)**

Unit 5: Refrigeration equipments:

Compressors: Functions, Reciprocating compressor, hermetically sealed compressor, Rotary compressor with sealing blade and eccentric motor. **Condensers:** Functions, Air cooled and water cooled condensers, Evaporative condensers, Cooling towers. **Evaporators:** Functions, Primary and Secondary evaporators, flooded evaporators, Dry expansion systems, Shell & coil evaporators.

Expansion Devices: Functions, Automatic expansion valve, Thermostatic expansion valve, Solenoid control valve, Low side and high side float valves. (Ref.1: Chapter -13)

(12 L, 16M)

(Total: 45 Periods, 60 Marks)

Reference Books:

1. A course in Refrigeration and Air –Conditioning: S.C. Arora & S. Domkundwar. Dhanpat Rai & Co. 7th Edition
2. Basic Refrigeration and Air –Conditioning: P.N. Ananthanarayanan , Tata Mcgraw Hill, New Delhi 3rd Edition
3. Principles of Refrigeration: Roy J Dossat , Pearson Education (Singapur) Ltd. 4th Edition

Semester V: (DSE): Physics paper VI

PHY 506(C): Vacuum Technology-I

(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Vacuum technology to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Vacuum technology.
2. To introduce the concepts and offer a fundamental insight to vacuum technology, the principles involved, pumps and gauges used.
3. To provide the knowledge and methodology necessary to create and maintain vacuum.
4. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept and use of knowledge of Vacuum technology to understand and solve real life problems.
2. Get knowledge of which pump to use to create vacuum.
3. Knowledge of which gauge to use for measuring vacuum.
4. Understanding of the course will create scientific temperament.

……

Unit 1: Basics for Vacuum

Atmosphere and Vacuum, Gas pressure, Equations of ideal gas, Fundamental assumptions of kinetic theory of gas, Mean free path, Gas diffusion, Viscosity of gas, Thermal conductivity, **(7P, 8M)**

Throughput and Speed, Different units of measurement of vacuum, Ranges of vacuum, Vacuum circuits: Impedance and Conductance, Mechanism of gas flow, pumping speed of vacuum pump. **(10P, 12M)**

Unit 2: High vacuum pumps

Rotating vane type rotary pump: principle, construction, working, ultimate pressure attainable, factors on which the optimum performance of the pump depends, pump characteristics. Oil diffusion vapour pump (single stage, multistage): principle, construction, working, ultimate pressure attainable, factors on which the optimum performance of the pump depends, pump characteristics. **(8P, 12M)**

Unit 3: Ultrahigh vacuum pumps

Turbomolecular pump, Sorption pump, Ion pump, Cryogenic pump: principle, construction, working, ultimate pressure attainable. **(10P, 14M)**

Unit 4: Vacuum gauges

U-tube manometer, Mc-Leod gauge, Thermal conductivity gauges- Thermocouple gauge, Pirani gauge, Semiconductor gauge, Ionization gauges- Hot cathode and Cold cathode gauge, Bayard-Alpert gauge. **(10P, 14M)**

(Total: 45 Periods, 60 Marks)

References:

1. Introduction to Theory and Practical of High Vacuum Technology : L.Ward & J.P. Bunn, Butterworths.
2. High Vacuum Techniques : J. Yarwood.
3. Design and Construction of Vacuum systems : G.W. Green.
4. Vacuum Sealing Techniques : A. Roth
5. High Vacuum Engineering : A.E. Barrington
6. Handbook of Vacuum Technology: Karl Jousten
7. Vacuum Physics and Techniques, T. A. Delchar, Chapman and Hall.

Semester V: (DSE): Physics paper VI

PHY 506(D): Microprocessor-I

(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Microprocessor to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Microprocessor.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept and use of knowledge of Microprocessor to understand and to solve real life problems.
2. Understanding of the course will create scientific temperament.

……

Unit-1: Fundamentals of Microcomputer

Simple microcomputer architecture, Microcomputer operation, Address bus, Data bus, control bus, memory, Semiconductor and Magnetic memory, Cache memory, RAM and ROM, High level and Low level language, Assembler, Compiler and Interpreter. **(12P, 16M)**

Unit-2: Architecture of 8085 Microprocessor

The 8085 pin diagram and function of each pin, Microprocessor communication and bus timings, Demultiplexing the bus AD7- AD0, Microprocessor Architecture and function of each block.

(12P, 16M)

Unit-3: Instruction Set of 8085 Microprocessor

Study of addressing mode for 8085:- Implied addressing, Register addressing, Immediate addressing, Direct addressing and Indirect addressing. Instruction set: Data transfer instructions, Arithmetic instructions, Logical instructions, Branching instructions, Stack/PUSH and POP instructions, I/O and Machine control instruction. **(15P, 20M)**

Unit-4: Stack and Subroutines

Stack, Subroutine, types of Subroutine and Macro **(06P, 08M)**

(Total: 45 Periods, 60 Marks)

References:

1. Fundamentals of Microprocessors and Microcomputers – Badri Ram, Dhanpat Rai& Sons, Delhi.
2. Microprocessor Fundamentals – Roger L. Tokheim.
3. 8085 Assembly Language Programing – L. A. Leventhal.
4. Microprocessor Architecture programming and Applications 8080 & 8085 – Ramesh Gaonkar.
5. 8086 Microprocessor programming and Interfacing – Gibson.
6. Advanced Microprocessor and peripherals (Architecture, programming and interfacing) – A. K. Ray, K. M. Bhurchandi.
7. Microprocessors and Microcomputers- Soumitra Kumar Mandal.

Semester V: (DSE): Physics Paper VI

PHY 506 (E): Programming in C ++ - I

(Credits: 03) :(45 Lectures 60 Marks)

Course description:

This course is aimed at introducing the fundamental Concept of Computer Programming language C++.

Course Objectives:

1. The course is designed to provide basic knowledge of C++ Programming.
2. C++ Programming is intended for software engineers, system analysts, program managers.
3. To learn how to design programs and applications using C ++.
4. To develop problem-solving skills and their implementation through C++ Programming.

Course Outcome: At the end of the course, the student will be able to

1. Explain basic principles of C ++ programming language
2. Concept of Variable, Operators, Control structure, Functions used in C++ programming.
3. Develop skills in writing a simple C++ program using a different statement.
4. Apply the best features of mathematics, engineering, and natural sciences to program real-life problems.

Unit 1: Elements of C++ **[L: 04 M: 8]**

What is C++?, applications of C++, comments, I/O streams, the structure of the C++ program.

Unit 2: Variable and Expressions **[L: 08 M: 12]**

Variables, tokens, keywords, identifiers and constants, basic data types, user-defined data types & derived data types. Declaration and initialization of variables.

Unit 3: Operators in C++ **[L: 08 M: 14]**

Scope resolution operators, member dereferencing operator, memory management operators, manipulators, type cast operator, expressions and their types**.**

Unit 4: Control structure **[L: 10 M: 10]**

If, if-else, else-if, switch, break, continue.

Loop structures: while, do-while, for, nested for loop.

Unit 5: Functions in C++ **[L: 10 M: 10]**

Introduction, function prototyping, call by value & call by reference, Inline functions, reference arguments and default arguments. Math library functions.

Unit 6: Introduction to arrays, structures & union in C++ **[L: 05 M: 6]**

Definition, declaration, examples.

[Total: 45 Periods, 60 Marks]

References :

1. Master in C++ - K.R.Venugopal
2. C++ Programming - E.Balaguruswami
3. Turbo C++ Programming - Robert Lafore
4. C++ Programming - Yashwant Kanitkar.

Semester V: (LAB): Physics paper VII

PHY 507: Physics practical -I

(Credits: 02): (60 L, 100M (40 Internal + 60 External))

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Perform any ten experiments:

1. Moment of Inertia by Bifilar suspension.
2. Y and η by Searl's method.
3. Y by Koenig's method.
4. Y by Newton's rings.
5. Searl's Goniometer.
6. Lloyd's single mirror.
7. To estimate temperature of Na flame.
8. Measurement of resistivity by four probe method.
9. Frequency of AC/ Tuning fork by stroboscope.
10. Variation of resistance of a filament of a bulb with its temperature.
11. Determination of velocity of sound using ultrasonic Interferometer.
12. Electromagnetic Pendulum.
13. Determination of circular aperture of LASER.
14. Measurement of self-inductance of a coil by Anderson's bridge.
15. To determine the human audibility.
16. Study of I-V characteristics of solar cell.
17. Determination of fill factor and efficiency of solar cell.
18. To determine the solar constant.

Semester V: (LAB): Physics paper VIII

PHY 508: Physics practical -II

(Credits: 02): (60 L, 100M (40 Internal + 60 External))

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Group A: Perform any five experiments (Solid state physics, Electronics, Instrumentation):

1. Hall effect.
2. Analysis of XRD pattern.
3. Measurement of resistivity by two probe method.
4. Characteristics of JFET.
5. UJT characteristics.
6. UJT as relaxation oscillator.
7. Study of RC/LC filter(Low pass and High Pass)
8. Study of Heartly oscillator. (Calculation of frequency and verification of frequency from sinusoidal output waveform)
9. Measurement of self inductance using Maxwell's induction bridge.
10. Multiplexer (2 to 1 or 4 to 1) and/or De-multiplexer (1 to 2 or 1 to 4).

{For more knowledge and understanding, one can help the students to study, understand and use the VESTA software for determination of crystal structure on the basis of given data.}

Group B: Perform any five experiments from the following any one optional courses:

A) Technical Electronics:

1. To make two PCB's i) Using discrete components ii) Using IC components.
2. To study inverting and non inverting configuration of Op amp.
3. To study of OP AMP as an adder.
4. DAC (R- 2R ladder, without OP- AMP).
5. To study reverse bias characteristics of photodiode.
6. To study characteristics of photo transistor.
7. To design and study of regulated power supply using IC 723.
8. Designing and fabrication of transformer.
9. Triangular, square wave generator using OP AMP.
10. V to F converter using IC-741.
11. V to T converter using IC-741.
12. Study of function generator.
13. To study fixed voltage regulator using 78XX and 79XX.

{For more knowledge and understanding, one can help the students to study, understand and use the SKYLAB software to write and execute programs to study out put of inverting or non- inverting configuration of OPAMP, Opamp as adder or subtractor etc}

B) Refrigeration and Air conditioning:

1. Study of different tools used in Refrigeration and Air Conditioning.
2. To carry out the following operations on Copper tube i) Cutting ii) Bending iii) Flaring.

3. Study of hermetically sealed compressor used in refrigeration systems.
4. To carry out Swaging and Brazing of Copper tubes.
5. Study of thermostatic switch, LP/HP cut out switch and filters used in Refrigeration and A. C. systems.
6. Leakage testing and charging of a refrigeration system.

C) Vacuum technology:

1. To describe function of various parts of Rotary pump (with schematic diagram).
2. To describe the constructional details & working of vapour diffusion pump.
3. To measure the pumping speed of vacuum system by steady state method.
4. Study of McLeod gauge.
5. To calibrate & study the function of Pirani gauge.
6. To evacuate a system with a rotary pump (measurement of vacuum with & without ballast using McLeod gauge).

D) Microprocessor:

1. Diode matrix ROM.
2. Application of DAC (square/triangular sweep wave).
3. Up-down counter (4-bit).
4. Hexadecimal/decimal counter.
5. Multiplexer/Demultiplexer (using IC).
6. Study of shift register (using IC).
7. Shift an 8-bit and 16-bit number left by one bit.
8. One's and Two's Complement of number.

E) Programming in C++:

1. Write a C++ program to display the string "T. Y. B. Sc. Physics"
2. Write a C++ program to make addition, subtraction, multiplication & division
3. Write a C++ program to demonstrate the use of scope resolution operator
4. Write a C++ program to check whether given no. is palindrome or not
5. Write a C++ program to demonstrate the use of the inline function for finding a maximum of two numbers
6. Write a C++ program to accept array elements as positive and negative nos. & only print positive nos. as output (use continue statement) e.g. {10, -20, 3, 5,-7} O/P: {10,3,5}
7. Write a C++ program to generate Fibonacci series up to 20 terms e.g. 1, 1, 2, 3, 5, 8,…… (20 terms)
8. Write a C++ program to create the following structure Roll-No. Stud-Name Class. Enter at least five records

Semester V: (LAB): Physics paper VII

PHY 509: Project -I

(Credits: 02): (60 L, 100M (40 Internal + 60 External))

ASSESSMENT OF PROJECT- FIRST TERM:

Student should submit a Progress Report on the work done by him/her during the First Phase of the project i.e. on the topics :

1. Project Selection
2. Literature Search Strategy
3. Literature Review
4. Project Planning.
5. Experimental work (30 to 40 %)

Instructions:

1. The topic of project of the first term must be continued in the second term.
2. The project report of first term should be maintained and should be produced to examiner of second term.
3. The student will have to give a seminar on the project topic in the practical exam.
4. The student must perform his project presentation by PPT on LCD projector.

Semester VI: (DSC): Physics paper I

PHY 601: Quantum Mechanics

(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Quantum Mechanics to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Quantum Mechanics.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept and use of knowledge of Quantum Mechanics to real life problems.
2. Understanding of the course will create scientific temperament.

……

Unit 1: The Schrodinger Equation

Introduction to Quantum Mechanics, Wave function and its Physical interpretation, normalized and orthogonal wave functions, Requirements of wave function, Formulation of time dependent and time independent Schrödinger equation (Steady state equation), Probability current density and equation of continuity, Solution of Schrodinger's equations, Energy eigenvalues and eigenfunctions, Expectation value, Ehrenfest's theorem, Postulates of Quantum Mechanics. (Ref:1, 2 and 9)

(14P, 14M)

Unit 2: Applications of Schrödinger steady state equation

Particle in a one dimensional rigid box (derivation of energy eigenvalues and eigenfunctions), Step potential (Probability of reflection (R) and transmission (T)), Linear Simple Harmonic oscillator (derivation of energy eigenvalues and eigenfunctions) (1D). (Ref: 2,6 and 7) **(12P, 16M)**

Unit 3: Quantum theory of Hydrogen atom

Schrödinger equation in spherical polar co-ordinate system, Schrödinger equation for Hydrogen atom-separation of radial and angular part, Solutions of R,Θ,Φ equations, Significance of quantum numbers n, l, m_l and m_s. (Ref: 1). **(09P, 14M)**

Unit 4: Operators in Quantum Mechanics

Operators and linear operators, Position, Momentum operator, angular momentum operator, and total energy operator (Hamiltonian), Commutator bracket, Commutator algebra, Commutator brackets using position, momentum and angular momentum operator, Commutation relations and Hamiltonian operator; Commutation rules for components of orbital angular momentum; Commutation relations of L^2 with components of orbital angular momentum; Commutation relation of components of orbital angular momentum with position operator, Ladder operators L_+, L_- Concept of parity, parity operator and its eigenvalues.(Ref: 2 and 4) **(10P, 16M)**

(Total: 45 Periods, 60 Marks)

References:

1. Perspectives of Modern physics : Arthur Beiser.
2. Advanced Quantum Mechanics: Satya Prakash, Kedarnath Ram Nath, Meerut
3. Quantum Mechanics: Gupta, Kumar, Sharma. Sultan Chand & Sons
4. Quantum Mechanics: Chatwal and Anand. Himalaya Publ. Co.
5. Quantum Mechanics: L.I.Schiff.
6. Quantum Mechanics: Powell and Crasemann, Addison-Wesley Pub. Co.
7. Introduction to Quantum Mechanics: D. Griffiths Published by Prentice Hall,
8. Quantum Physics: 2nd Ed. H.C. Verma, Surya Publications, Ghaziabad (UP), 2009.
9. Quantum Mechanics: Concepts and Applications, Nouredine Zettili, Wiley Publications.

Semester VI: (DSC): Physics paper II
PHY 602: Material Science
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Material Science to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Material Science.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept of use of knowledge of Material Science to real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Introduction to materials

Classification of materials

Properties of Materials: **Mechanical Properties**:. Interpretation of tensile stress – strain curve, Stress, strain (tensile, compressive and shear), strength, elasticity, plasticity, ductility, malleability, hardness, toughness, creep, fatigue, stiffness, Isotropy, Anisotropy, Deformation, Elastic and Plastic deformation, factor affecting the mechanical properties, **Thermal Properties**: Heat capacity, Thermal expansion, Thermal conductivity, **Electrical Properties**: Conductivity, resistivity, dielectric strength, piezoelectricity. **Optical Properties**: Wavelength spectrum of electromagnetic waves. Refraction, Reflection, absorption and Transmission of non-metallic materials. **(12P, 15M)**

Unit 2: Atomic disorder in materials

Solid solution: Types of solid solution - Substitutional and Interstitial solid solution, Hume Rothery Rules of solid solubility. **Imperfections or defects in solids**: (i) Point defects: vacancies, Frenkel defect, Schottky defect, (ii) Line defects (Dislocation): Edge dislocation, screw dislocation**,** (iii) Surface defects or interfacial defects and (iv)Volume defect. **Plastic deformation**: Mechanism by slip system. **(06P, 10M)**

Unit 3: Diffusion of solid material

Atomic diffusion- Introduction, Classification of Diffusion.

Diffusion mechanism – Vacancy mechanisms, Interstiitial mechanism, Direct interchange mechanism. Diffusivity, Self diffusion in nickel, Steady state Diffusion (Fick's first law of diffusion) and Non steady state Diffusions (Fick's second law of diffusion), variation of diffusivity with temperature ,Activation energy for diffusion, factor affecting the diffusion. **(09 P, 12M)**

Unit 4: Phase Diagram

Phase diagram, Phase equilibrium, Construction of phase diagram, Interpretation of phase diagram, Gibb's Phase rule, classification of phase diagram - Unary Phase diagram, Binary Phase Diagram, Binary Phase Diagram for: i) Sugar-Water, ii) NaCl-water, Eutectic reaction, lever rule, Sb-Bi phase diagram, Pb-Sn phase diagram**.** **(10 P, 13M)**

Unit 5: Organic Materials:

Polymers: Properties of polymer, Molecular weight, Molecular structure, **Types of Polymers**: Plastics and elastomers, Plastic: Thermoplast, Thermosets Polymerization, Mechanism of polymerization, Degree of polymerization, Addition Polymerization, Co-Polymerization, and Condensation Polymerization. **(08P, 10M)**

(Total: Periods 45, Marks 60)

References:

1. Materials Science & Engineering: An Introduction (6th Edition): William D. Callister
2. Elements of Materials Science & Engineering: Van Vlack
3. First Course in Materials Science & Engineering: V Raghavan.
4. Material Science: S. L. Kakani, Amit Kakani. New Age International Publishers.
5. Material Science : G.K.Narula and K.S.Narula, Tata McGraw Hill.
6. Material Science and Processes : S.K.Hajra – Chaudhari, Indian Book Distributing company.

Semester VI: (DSC): Physics paper III
PHY 603: Nuclear Physics
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Nuclear Physics to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Nuclear Physics.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept and use of knowledge of Nuclear Physics to understand and solve the real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Nucleus and Nuclear Forces

Nuclear compositions:- Constituents, charge, size, density, atomic mass of nucleus, nuclear magnetic moment, concept of parity(even and odd), classification of nuclei, mass defect and binding energy, stability of nuclei, packing fraction, Problems. Nuclear forces: Nuclear force, features of nuclear forces, saturation and short range nuclear forces, charge symmetry and charge independence, spin dependence of nuclear force, Meson exchange theory of nuclear forces, Elementary particles (List only). **(9L, 12M)**

Unit 2: Radioactivity

Introduction, Law of radioactive decay, half life, mean life, specific activity, partial radioactive decay, successive disintegration, Applications of radioactivity (Agricultural, Biological, Medical and industrial), Problems. **(06L, 08M)**

Unit 3: Nuclear Models

Types of nuclear models (List only), Single particle shell model**:** Introduction, Assumptions, Evidence of shell model, Theory of nuclear shell potential, nuclear spin and parities, limitations of shell model. Liquid drop model**:** Introduction, assumptions, semi-empirical mass formula. Limitations of Liquid drop model, Problems**.** **(07L, 09M)**

Unit 4: Nuclear Reactions

Introduction, Theories of nuclear reactions, conservation laws, Q-value equation, Energetic of exoergic reactions, Energetic of endoergic reactions, Threshold energy, Problems. **(07L, 09M)**

Unit 5: Nuclear Energy

Introduction, Nuclear fission, Explanation on the basis of liquid drop model, energy available from fission:- Estimation of energy from masses of fission fragments and from binding energy, Nuclear chain reaction, Nuclear Fusion, Nuclear Reactor: Basic principle, classification, constituents parts, Heterogeneous reactor, Swimming pool reactor, Power reactor, Problems. **(10L, 14M)**

Unit 6: Nuclear Detectors and Accelerators

Types of detectors, Geiger-Mueller counter, Scintillation counter, Classification of accelerators**:** Cyclotron and Betatron. **(06L, 08M)**

(Total: 45 Lectures, 60 Marks)

References:

1. The atomic Nucleus: R D Evans, McGraw Hill Book Company.
2. Nuclear Physics: D C Tayal, Himalaya Publishing House, Bombay.
3. Nuclear Physics: Irving Kaplan, Narosa Publishing House, New Delhi.
4. Basic Nuclear Physics and Cosmic Rays: B N Srivastava, Pragati Prakashan, Meerut.
5. Concepts of Modern Physics – Arthur Beiser (5th Edition).
6. Atomic Physics: J.B. Rajam.
7. Introduction to Nuclear Physics: H.A. Enge (Addition Wesely Co.)

Semester VI: (DSC): Physics paper IV
PHY 604: Modern and Applied Physics
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Modern and Applied Physics to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Modern and Applied Physics.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept and use of knowledge of Modern and Applied Physics to understand and solve the real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Plank's Quantum theory:

Planck's quantum theory, properties of photon, Planck's constant and light as a collection of photons; photo-electric effect and Compton effect, Experimental verification of Compton's effect. **(04 P, 06 M)**

Unit 2: Bohr's and Sommerfield theories of hydrogen atom

Introduction of atomic spectra, Inadequacy of classical planetary model of hydrogen atom, Bohr's theory of hydrogen atom, Extension of Bohr's theory, Experimental verification of discrete atomic energy levels, correspondence principle, Bohr's Sommerfield model and relativistic effects, Limitations of quantum mechanical model. **(09 P, 12 M)**

Unit 3: Matter Waves (Foundation of Quantum mechanics)

Need of quantum mechanics, Wave particle duality of matter, de-Broglie hypothesis, Expression for matter waves, Electron diffraction , Davission and Germer experiment, concept of wave group , phase velocity, group velocity, particle velocity and relations between them, Uncertainty principle, Thought experiment (Gamma ray microscope), different forms of uncertainty principle, applications of uncertainty principle (Non existence of electron in nucleus, determination of ground state of electron and size of hydrogen atom). (**09 P, 12 M**)

Unit 4: Fiber Optics

Introduction, construction of optical fiber, principle of operation, concept of acceptance angle, numerical aperture, attenuation in optical fiber and attenuation limit, preparation of optical fiber, optical fiber materials, types of optical fiber Single mode and multimode fibers, advantages and disadvantage of optical fiber, communication, Applications of fiber optics, Detail discussions on following applications: Temperature sensor, displacement sensor, fiber optic endoscopy, fiber optic communications.

(07P, 09 M)

Unit 5: Holography and its application

Concept of monochromatic and coherent source, basic idea of hologram, construction and re-construction hologram, types of hologram (list only), application of holography in microscopy and character recognition. **(07P, 09 M)**

Unit 6: Introduction to bioelectricity

Electricity observed in living systems, examples and origin of bioelectricity, sodium and potassium transport, Nernst equation, resting and action potential, conduction velocity. **(09 P, 12 M)**

Total: (45 Periods, 60 Marks)

References

1. Concepts of Modern Physics: S. L. Gupta, S. Gupta, Third Edition-1989, Publisher: Dhanpat Rai and Son's.
2. Modern Engineering Physics: A. S. Vasudevan, Publisher: S Chand.
3. Physics for Engineers: M.R. Srinivasan, Publisher: New Age International.

4. REFRESHER COURSE IN PHYSICS, VOLUME-II, C. L. Arora, Publisher: C. Chand and Company Ltd., New Delhi.
5. Modern Physics – B. L. Theraja, Publisher: C. Chand and Company Ltd., New Delhi.
6. Elementary Modern Physics - Atam P. Arya, Publisher: Addison Wesley Longman Publishing Co., New edition
7. An Introduction to Lasers -Theory and Applications - M. N. Avadhanalu, Publisher: C. Chand and Company Ltd., New Delhi.
8. Introduction to Fiber Optics: Ajoy Ghatak, K. Thyagarajan, Publisher: Cambridge University Press, 1998.
9. From Neuron to brain - Kuffer & Nicholas, Publisher: Sinauer Associates is an imprint of Oxford University Press; 5 edition (2011).
10. Biomedical Instrumentation and Measurements (II Edition) - L. Cromwell, F. J. Weibell, E. A. Pfeiffer (Pearson Education Singapore Pvt. Ltd.).

Semester VI: (SEC): Physics paper V

PHY 605: Basic Instrumentation Skills

(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Basic Instrumentation skills to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Basic Instrumentation skills.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Handle and use various basic mechanical and electrical measuring instruments
2. Understanding of the course will create scientific temperament.

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(This course is to get exposure with various aspects of instruments and their usage throughhands-on mode. Experiments listed below are to be done in continuation of the topics.)

Unit 1. Use of basic measuring instruments:

Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. Study of Vernier calliper, Screw gauge, travelling microscope and their utility to measure the dimension of a solid block, volume of cylindrical objects, diameter of a thin wire and capillary tube, thickness of metal sheet, etc. Use of Sextant to measure height of buildings, mountains, etc.

(04 P, 06M)

Unit 2. Electrical quantity measuring instruments:

PMMC, Voltmeter (D.C. and A.C), specifications and their significance. Ammeter (D.C. and A.C), specifications and their significance. Ohmmeter (Series and Shunt type), specifications and their significance. Multimeter, Steps of measurement of dc voltage and dc current, ac voltage, ac current and resistance using multimeter, Specifications of a multimeter and their significance. **(12 P, 14M)**

Unit 3: Cathode Ray Oscilloscope

Block diagram of basic CRO, Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor, visual persistence and chemical composition. Time base operation, synchronization. Front panel controls. Specifications of a CRO and their significance, Use of CRO for the measurement of voltage (dc and ac), frequency, time period and phase. Introduction of Dual trace CRO and digital oscilloscope, probes. **(12P, 14M)**

Unit 4: Signal Generators and Analysis Instruments

Block diagram, explanation and specifications of low frequency signal generators, pulse generator, and function generator. Brief idea for testing, specifications. **(07P, 10M)**

Unit 5: Digital Instruments

Principle and working of digital meters. Comparison of analog and digital instruments. Characteristics of a digital meter. Block diagram and Working principle of digital voltmeter (Ramp type only). Block diagram and working of a digital multimeter, Digital Frequency meter: Block diagram and Working principle: frequency and period measurement, accuracy and resolution.

(10P, 16M)

Total: (45 Periods, 60 Marks)

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The test of lab skills will be of the following test items:

1. Use of an oscilloscope.

2. CRO as a versatile measuring device.
3. Circuit tracing of Laboratory electronic equipment,
4. Use of Digital multimeter for measuring voltages
5. Trouble shooting a circuit

Laboratory Exercises:

1. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.
2. To observe the limitations of a multimeter for measuring high frequency voltage and currents.
3. Measurement of voltage, frequency, time period and phase angle of a wave using CRO.
4. Measurement of time period, frequency, average period using universal counter/ frequency counter.
6. Measurement of rise, fall and delay times of a wave using a CRO.
7. Measurement of distortion of a RF signal generator using distortion factor meter.

Open Ended Experiments:

1. Using a Dual Trace Oscilloscope
2. Converting the range of a given measuring instrument (voltmeter, ammeter)

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Reference Books:

1. Principles of Electronics – V. K. Mehta, S. Chand Publications, New Delhi.
2. Basic Electronics (Solid State): B.L. Thereja, Publisher: S. Chand and Company, New Delhi.
3. Electrical measurements and measuring instruments: R K Rajput, S. Chand and Co. New Delhi.
4. Digital Principles and Applications: A.P. Malvino and D. P. Leach. Tata McGraw-Hill Publishing Company Limited, New Delhi.
5. Modern Electronic Instruments and Measurement techniques: Albert D. Helfrick, Willam D. Cooper, Prentice Hall India Pvt. Ltd, New Delhi.
6. A course in Electrical and Electronic Measurements and Instruments: A. K. Sawhney, Dhanpat Rai and Sons.
7. Digital electronics, R P Jain
8. Basic Electronics: B. Grob, Publisher: McGraw Hill Book Co. New York,
9. Electronic Instrumentation: H.S. Kalsi, Tata McGraw-Hill Publishing Company Limited, New Delhi.
10. Digital instrumentation by A J Bouwens
11. A text book in Electrical Technology - B L Theraja – S. Chand and Co.
12. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
13. Logic circuit design, Shimon P. Vingron, 2012, Springer.
14. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
15. Electronic Devices and circuits, S. Salivahanan and N. S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill
16. Electronic circuits: Handbook of design and applications, U.Tietze, Ch.Schenk, 2008, Springer
17. Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India

Semester VI: (DSE): Physics paper VI
PHY 606(A): Technical Electronics II
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Technical Electronics to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Technical Electronics.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept of use of knowledge of Technical Electronics to real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Sound System

Microphones: characteristics, types (list only), carbon microphone and dynamic type microphone (Principle, construction and working), Loud speakers: Characteristics, Dynamic (Moving coil type) speaker, Multiway speaker system (woofer and tweeter), Connection type of speakers (series, parallel and series-parallel type). [R1, R2, R9]. **(08P, 12M)**

Unit 2: Public Address System

Block diagram of Public Address (P.A.) system and its explanation, requirements of P. A. system, typical P.A. Installation planning (Auditorium having large capacity, college sports), Volume control, Tone control and Mixer system, Concept of Hi –Fi system, Monophony, Stereophony, Quadra phony, Dolby A and Dolby B system, CD- Player: Block diagram of CD player and function of each block. [R1, R2, R9]. **(10P, 14M)**

Unit 3: Medical instruments.

Biopotential, Types of electrodes, ECG (principle, block diagram, features) Ultrasonography: working principle [R 3, 4, 5] **(07P, 8M)**

Unit 4: Transducer

Definition, Classification, Selection of transducer, Electrical transducer: Thermistor, Thermocouple, Pressure Transducer: Strain gauges (wire, foil, & semiconductor), Displacement transducer: LVDT, Peizo-electric Transducer, Optoelectronic transducers: LDR, Chemical sensors: pH sensor, Gas sensor (Fundamental aspects), Humidity sensor (Resistive). [R7, R8]. **(10P, 14M)**

Unit 5: Modern appliances

Remote Control: Operating principle, block diagram, features.

Microwave Oven: Operating principle, block diagram, features.

Cellular Phone: Operating principle, Block diagram, specifications, features, and functions performed.

Washing Machine: Operating principle, block diagram, features, Fuzzy Logic (Idea only),

Electronic Weighing Systems: Operating principle, Block diagram, features. [R8].

Infrared Thermometer: Operating principle, Block diagram, features. **(10P, 14M)**

(Total: 45 Periods, 60 Marks)

References:

1. Audio and Video Engineering System: R.G. Gupta, Tata Mc-GrawHill Publishing Company Ltd, New Delhi.
2. Basic Electronics: B. L. Thereja, S. Chand Publications, New Delhi.

3. Introduction to Bio-medical Electronics: Joseph-Du-bary, Tata Mc-Graw Hill Publishing Company Ltd, New Delhi.
4. Medical instrumentation Application and design: J. C. Wobster
5. Biomedical instruments and measurements: L. Cromwell, F. J. Weibell, Printice Hall of India of India Pvt. Ltd, New Delhi.
6. Transducers and display systems: B.S. Sonde, Tata McGraw-Hill Publishing Company Limited, New Delhi.
7. Solid state Gas sensors- edited by P. T. Moseley and B.C. Tofeld, Harwell, Adam Hilger and Philadelphia
8. Measurement and Instrumentation Principles: Alan S. Morris, Butterworth-Heinemann.
9. Consumer Electronics: J.S. Chintode, Technical Publication, Pune.

Semester VI: (DSE): Physics paper VI
PHY 606(B): Refrigeration and Air conditioning II
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Refrigeration and air conditioning to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Refrigeration and air conditioning.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept and use of knowledge of Refrigeration and air conditioning to understand and solve the real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Psychrometry:

Introduction, Meaning of air conditioning, Five main factors of comfort air conditioning, Psychrometry and psychrometic properties, psychrometic relations: Dalton's law of partial pressure; relation between partial pressure & specific humidity; relation between degree of saturation & relative humidity, Types of psychrometers, Psychrometic processes, Bypass factor and its relation, Summer air conditioning systems for Hot & Dry; Hot & Humid out door conditions, Summer air conditioning with evaporative cooling, Winter air conditioning system for mild cold weather. (Ref. 1: Chapter -16) **(12L, 16M)**

Unit 2: Cooling load calculations & design of air conditioning systems:

Different heat sources, Heat flow due to conduction, Sun load, Occupants load, Equipment load, Infiltration load, Miscellaneous heat sources, Design aspects of air conditioning system, Cooling load and air quantities. (Ref. 1: Chapter -19) **(7L, 10M)**

Unit 3: Air Conditioning equipments:

Air cleaning and Air Filters: Functions, Types, Wet filters, Electronic filters, and Centrifugal dust collector. Cooling Coils: Bypass factor of multidepth coils. Humidifiers: Functions, Atomization type humidifiers, Impact type humidifiers, Pan & coil type humidifiers. Dehumidifiers: Functions, Refrigeration humidifiers, Spray type humidifiers, De-humidifying air washers. Fans and Blowers: Functions, Axial flow fans, Centrifugal fans. Grills and Registers. (Ref. 1: Chapter -25) **(10L, 14M)**

Unit 4: Air Conditioning Control systems:

Basic elements of control systems, Temperature control elements: Bimetal type thermostat, Sealed bellow type thermostat, Electrical resistance and thermocouple type thermostat. Humidity Control Elements: Hair type humidistat, Absorption type thermostat, Water vapour recorder. Actuators: Relays Introduction to Transmission systems:Pre heat and humidification control systems, Cooling dehumidification and reheat control system, Face and bypass control system. (Ref. 1: Chapter -26) **(10L, 12M)**

Unit 5: Solar Refrigeration System

Vapour Compression Refrigeration system using solar energy, Vapour absorption refrigeration system using solar energy, Solar refrigeration using a solid absorption cycle, Solar refrigerators sing Photovoltaic panels, (Ref.1: Chapter -28) **(6L, 8M)**

(Total: 45 Periods, 60 Marks)

Reference Books:

1. A course in Refrigeration and Air –Conditioning: S.C. Arora & S. Domkundwar.Dhanpat Rai & Co. 7th Edition
2. Basic Refrigeration and Air –Conditioning: P.N. Ananthanarayanan , Tata Mcgraw Hill, New Delhi 3rd
3. Principles of Refrigeration: Roy J Dossat , Pearson Education (Singapur) Ltd. 4th Edition

Semester VI: (DSE): Physics paper VI
PHY 606(C): Vacuum Technology-II
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Vacuum technology to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Vacuum technology.
2. The course should prepare the student for operating, simulating and construction of vacuum systems.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply important laws of physics which govern how a vacuum system works.
2. Account for which components are used in a vacuum system, their construction, function and use.
3. Account for troubleshooting a vacuum system.
4. Run simulations and write a specification for a simple vacuum system.

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Unit 1: Vacuum materials and components

Adsorption, Absorption, Desorption. Diffusion and penetration of gases through solid surfaces, Vapour pressure of different materials, Outgassing of materials, Desired properties of materials used for fabrication of vacuum system. **(7P, 8M)**

(i) Vaccum Seals: (a) Permanent seals- Welding, Brazing, Soldering (b) Demountable seals- Waxes, Resins and Adhesives, Gaskets seal: Elastomer, metal. Feedthroughs: Electrical Feedthroughs, Motion Feedthroughs: Wilson seal, Bellows seal. **(8P, 11M)**

(ii) Valves: (a) Roughing and For-line valves: Disk valve, Ball valve. (b) High vacuum valves: Gate valve, disk valve, flap valve, Butter-fly valve. (c) Gas admittance valves: disk valve, Needle valve. **(8P, 11M)**

Unit 2: Leak detection

Real and Virtual leaks, Leak detection method: (a) Over pressure method- Bubble method, Halide torch, Sniffer technique. (b) Low pressure method- Blocking (sealing) method, Tesla coil, Halogen leak detector, Organic vapour and gas probe with suitable pressure gauge as detector. **(11P, 14M)**

Unit 3: Vacuum system fabrication

General consideration of designing, Construction of High vacuum system (Combination of Rotary and Oil diffusion pump), Its operational procedure, Construction of Ultrahigh vacuum system and its operational procedure. **(8P, 11M)**

Unit 4: Application of Vacuum Technology

Applications of Vacuum technology in Research and Industry. **(3P, 5M)**

(Total: 45 Periods, 60 Marks)

References:

1. Introduction to Theory and Practical of High Vacuum Technology : L.Ward & J.P. Bunn, Butterworths.
2. High Vacuum Techniques : J. Yarwood.
3. Design and Construction of Vacuum systems : G.W. Green.
4. Vacuum Sealing Techniques : A. Roth
5. High Vacuum Engineering : A.E. Barrington
6. Handbook of Vacuum Technology: Karl Jousten
7. Vacuum Physics and Techniques, T. A. Delchar, Chapman and Hall.

Semester VI: (DSE): Physics paper VI

PHY 606(D): Microprocessor- II

(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Microprocessor to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Microprocessor.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept and use of knowledge of Microprocessor to understand and to solve real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Assembly Language Programming

Masking of 4- MSB and LSB of given number, One's and two's complement of 16- bit numbers, Shift 16- bit numbers left by one bit, 8- bit addition, 8- bit subtraction, Decimal addition and decimal subtraction of two 8 bit numbers, 8- bit multiplication, Find largest and smallest numbers from a series of given number, Find square root of given number from Look up table. Code conversion programs:-Hex to ASC II conversion, BCD to binary conversion, Decimal to seven segment conversion. **(15P, 20M)**

Unit 2: Interfacing of Memory and Peripheral Devices

Introduction, Interfacing with RAMS & ROMS, I/O interfacing basics, Interfacing with practical I/O memory mapped I/O and I/O mapped I/O schemes, Direct Memory Access (DMA). Data transfer.

(09P, 12M)

Unit 3: Programming Peripheral Interface (PPI)

Architecture of Intel-8255, Pin diagram of Intel-8255, Functions of each pin, Control word format, Operations of Mode-0, Mode-1 & Mode-2**.,** Single-Bit Set/Reset (BSR) Mode and Applications of 8255 PPI (list only) . **(10P, 13M)**

Unit 4: Programming Communication Interface and Counter/Interval Timer

Architecture of Intel-8251, Pin diagram of Intel 8251, Functions of each pin, Mode word format, Control word format, Status word format, Architecture of Intel-8253, pin diagram of Intel-8253, Functions of each pin, Operations of Mode-0, Mode-1, Mode-2, Mode-3, Mode- 4 and Mode-5.

(11P, 15M)

(Total: 45 Periods, 60 Marks)

References:

1. Fundamentals of Microprocessors and Microcomputers – Badri Ram, DhanpatRai& Sons, Delhi.
2. Microprocessor Fundamentals – Roger L. Tokheim.
3. 8085 Assembly Language Programing – L. A. Leventhal.
4. Microprocessor Architecture programming and Applications 8080 & 8085 – Ramesh Gaonkar.
5. 8086 Microprocessor programming and Interfacing – Gibson.
6. Advanced Microprocessor and peripherals (Architecture, programming and interfacing) – A. K. Ray, K. M. Bhurchandi.
7. Microprocessors and Microcomputers- Soumitra Kumar Mandal.

Semester VI: (DSE): Physics paper VI

PHY 606 (E): Programming in C+ + - II

(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the object-oriented concept Programming language C++.

Course Objectives:

- To learn Object-Oriented Design with C++ Programming
- Ability to write a computer program to solve a specific program
- To handle abnormal termination of a program using exception handling

Course Outcomes:

1. Acquire knowledge of Object and Class.
2. Explore polymorphism using function overloading and operator overloading.
3. Understand the different aspects of the hierarchy of classes and their extensibility
4. Understands the concept of Virtual function, streams, and files, Generic Programming.
5. Write programs for handling run time errors using exceptions

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Unit 1: Objects & Classes **[L: 06 M: 08]**

Simple classes (class specification, C++ objects, accessing class members), constructors and destructors, constant member functions.

Unit 2: Functions and operator overloading **[L: 10 M: 12]**

Overloading functions, introduction to operating overloading, overloading unary and binary operators, overloading arithmetic assignment operator.

Unit 3: Inheritance **[L: 10 M: 10]**

Derived class and base class, derived class constructors, public and private inheritance, multiple inheritances, hierarchical inheritance, multilevel inheritance, containership (classes within classes).

Unit 4: Virtual functions **[L: 06 M: 10]**

Virtual functions, pure virtual functions, friend functions, Static functions, copy constructor, this pointer.

Unit 5: Generic programming **[L: 05 M: 10]**

Introduction to a template, function within a template, introduction to exceptional handling.

Unit 6: File and streams **[L: 08 M: 10]**

Input/Output streams, classes for steam operation, opening and closing files, file pointers and their manipulations, error handling during file operations.

(Total: 45 Periods, 60 Marks)

References:

1. Master in C++ - K.R.Venugopal
2. C++ Programming - E.Balaguruswami
3. Turbo C++ Programming - Robert Lafore
4. C++ Programming - Yashwant Kanitkar.

Semester VI: (LAB): Physics paper VII

PHY 607: Physics practical -I

(Credits: 02): (60 L, 100M (40 Internal + 60 External))

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Perform any TEN experiments:

1. Surface tension by Quinke's method.
2. Surface tension by soap bubble method.
3. Characteristics of G.M. counter.
4. Diffraction by straight edge/cylindrical obstacle.
5. e/m using Thomson's method.
6. Viscosity by rotating cylinder method.
7. Determination of 'g' by conical pendulum.
8. Study of oscillatory charge and discharge through an inductance and resistance.
9. To determine value of Boltzmann Constant using V-I characteristics of PN diode.
10. To determine work function of material of cathode using photocell.
11. To determine value of Plank's constant using LEDS of at least four different colours.
12. To study intensity response of photocell and verify inverse square law of radiations.
13. To measure the numerical aperature of an optical fiber.
14. Study of bending loss in optical fiber.
15. Study of I-V characteristics of photocell.
16. Determination of Plank's constant of Photocell.
17. Study of Solar still for water distillation.
18. Study of box type Solar cooker.

Semester VI: (LAB): Physics paper VIII

PHY 608: Physics practical -II

(Credits: 02): (60 L, 100M (40 Internal + 60 External))

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Group A: Perform any Five experiments (Material Science, Electronics, Instrumentation):

1. Determination of curie temperature of Ferrite.
2. Determination of specific heat of graphite at different temperature
3. To study characteristics of thermisters.
4. Determination of thermoelectric power.
5. Study of Astable Multivibrator using IC 555.
6. Binary weighted DAC (R-2R ladder) using OP-AMP.
7. Determination of Core losses in transformers.
8. To study of clocked RS flip flop using NAND gates.
9. Study of IC 7490 as mod 2, mod 5 and mod 10 counter.
10. To study RC coupled Single stage transistor amplifier. (Voltage gain , Frequency response)

Group B: Perform any Five experiments from the following optional courses:

A) Technical Electronics:

1. To study characteristics of LDR.
2. Study of P. A. system (series and parallel connection of two speakers) and measurement of equivalence resistance.
3. Use of C.R.O as a measurement tool for different electrical parameters (frequency, a. c./d. c. voltage, pulse height, pulse width, rise time and fall time).
4. Use of thermocouple for measurement of temperature.
5. Study of OP AMP as substractor.
6. Study of OP- AMP as a differentiator.
7. Study of OP- AMP as an integrator.
8. Displacement measurement using LVDT.
9. Frequency response of loudspeaker (twitter, woofer, mid-range).
10. Study of E.C.G .
11. Thermister as a thermometer using IC 741.
12. Half wave precision rectifier using OP AMP.
13. Full wave precision rectifier using OP AMP.

B) Refrigeration and Air conditioning:

1. To find the COP of a domestic refrigeration system.
2. Detection of trouble/faults in a refrigerator and window air conditioner.
3. Dismantling of Window type A.C. and testing after assembly.
4. Visit to a cold storage plant.
5. Visit to a centrally air conditioned building.
6. Visit to a Ice plant.

C) Vacuum technology:

1. To measure the pumping speed of vacuum system (use of Gaedes equation).
2. Demonstration of oil diffusion pump & to evacuate the system & to measure the ultimate vacuum.
3. To study the effects of conductance of pumping speed of oil diffusion pumping module.
4. Deposition of metallic thin film.
5. To investigate the variation of pumping speed of vapour diffusion pumping module with the pressure in vacuum system.
6. Pumping speed measurements using the constant volume method.

D) Microprocessor:

1. Find square root/square of number using look up table.
2. 8-bit decimal addition/subtraction.
3. Find largest/smallest number from series of 8-bit numbers.
4. Conversion of Hexadecimal to ASCII code.
5. 8-bit binary multiplication.
6. LED interface (Time delay generation).
7. Interfacing of thumbwheel switch.
8. Conversion of 8-bit Hexadecimal number to binary number.

E) Programming in C++:

1. Write a C++ program to implement string operations i) strlen ( ) ii) strcat ( ) as class members. Write a C++ program to display the string "T. Y. B. Sc. Physics"
2. Write a C++ program to swap two integers, two floats and two-character variables using function overloading.
3. Write a C++ program to demonstrate the use of constructors and destructors.
4. Write a C++ program to overload + operator to add two complex nos.
5. Write a C++ program to implement hierarchical inheritance.
6. Write a C++ program to implement multiple inheritances.
7. Write a C++ program to implement virtual functions.
8. Write a C++ program to demonstrate the use of function templates

Semester VI: (LAB): Physics paper VIII

PHY 609: Project II

(Credits: 02): (60 L, 100M (40 Internal + 60 External))

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ASSESSMENT OF PROJECT- SECOND TERM:

Student should submit a Final Project Report on the work done by him/her during the First and Second Phase of the Project i.e. on the topics:

1. Experimental work. (remaining further work in continuation with the work in the first term)
2. Characterize the samples, if any.
3. Discussion of the results.
4. Conclusions.

Instructions:

1. The topic of project of the first term must be continued in the second term.
2. The project report of first term should be maintained and should be produced to examiner of second term.
3. The student will have to give a seminar on the project topic in the practical exam.
4. The student must perform his project presentation by PPT on LCD projector.

CAREER OPPORTUNITIES FOR B. Sc. PHYSICS STUDENTS

B.Sc. Physics students can find jobs in public as well as in private sectors. There are many opportunities available for B. Sc Physics students in technical as well as scientific fields. They can work as Science and Mathematics Teachers, Quality Control Manager, Laboratory assistant, Laboratory Technician, School Science Technician in any government or private organization.

Private Sector:

There are many opportunities available in IT field for B. Sc (Physics) graduates. Many IT companies such as Infosys, Wipro and TCS are recruiting B. Sc. Physics graduates for software jobs. They can also get jobs in Energy Plants. Another jobs available for these graduates is Technician in Electronic Industry. They can apply for jobs in many companies in automobile industry. Some of those companies are Maruti Udyog, TATA Motors and Tech Mahindra. The B. Sc. (Physics) graduates can apply and secure their job in Solar devices production industries, electrical or electronic industries with their skills developed while syudying.

Government Sector:

There are vast opportunities available for B. Sc graduates in Government sector. They can apply for jobs in Scientific Research and Development Organizations such as The Defense Research and Development Organization (DRDO), CSIR, Physical Research Laboratory (PRL) Ahmedabad, Saha Institute of Nuclear Physics Kolkata and Nuclear Science Centre New Delhi. They can also apply for various jobs in popular government organizations such as Bhabha Atomic Research Centre (BARC), Atomic Energy Regulatory Board (AERB), Oil and Natural Gas Corporation (ONGC), Bharat Heavy Electricals Limited (BHEL), National Thermal Power Corporation (NTPC).

They can also apply for the various competitive exams conducted by Union Public Service Commission such as IFS, IPS and IAS. Several other government exams conducted for recruiting B. Sc Physics graduates are Tax Assistant Exam, Statistical Investigator Exam, Combined Graduate Level Exam.

Another option available for B. Sc Physics graduate is to apply for jobs in public sector banking. Several banks are conducting exam every year for recruiting graduates to the post of Probationary Officers. They can also find many jobs in Railway sector. They should qualify the exams conducted by Railway Recruitment Board to get a job in Railway sector. These graduates can also apply for Combined Defense Services Exams conducted for recruiting candidates to various posts in Defense Department.