SCIENCE FACULTY

NORTH MAHARASHTRA UNIVERSITY, JALGAON

SYLLABUS

FOR

F. Y. B. Sc.

PHYSICS

(With effect from June - 2015)

NORTH MAHARASHTRA UNIVERSITY, JALGAON

Class: F. Y. B. Sc.

Subject: Physics

With effect from June-2015

The Board of Studies in physics in its meeting held on **5th March 2015** has unanimously accepted the revised syllabus prepared by different committees, discussed and finalized in workshop for F. Y. B. Sc. Syllabi revision. The titles of the papers for F. Y. B. Sc. (Physics) are as given below;

Semester	Course Title	Periods	Marks	
			Ext.	Int.
I	PHY-111: MECHANICS AND PROPERTIES OF MATTER	45	60	40
	PHY-112: ELECTRICITY AND MAGNETISM	45	60	40
	PHY-113: PRACTICAL COURSE - I	45	60	40
II	PHY-121: HEAT AND THERMODYNAMICS	45	60	40
	PHY-122: THEORETICAL PHYSICS	45	60	40
	PHY-123: PRACTICAL COURSE - II	45	60	40

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

PHY-111: MECHANICS AND PROPERTIES OF MATTER

UNIT-I: DYNAMICS OF RIGID BODIES

Compound pendulum, Differential equation of motion, time period, explanation of length of equivalent simple pendulum, point of suspension & point of oscillation and their interchangeability, condition of minimum time period, Kater's pendulum and its application to determine 'g', Torsional pendulum and its application to determine modulus of rigidity, Bifilar suspension, Bifilar pendulum with parallel threads.

(12 Periods, 18 Marks)

UNIT-II: ELASTICITY

Introduction, Bending of beams, Bending moments: general expression and expressions for beams having rectangular and circular cross-section, Cantilever: cantilever loaded at the free end (general expression for depression), Expressions for cantilevers having rectangular and circular cross section, General expression for depression of a beam supported at its both ends and loaded in the middle , expressions for the beams having rectangular and circular cross-section, Experiment to determine 'Y' by bending of a beam.

(12 Periods, 15 Marks)

UNIT-III: SURFACE TENSION

Basic concepts of surface tension and angle of contact, Pressure difference across a liquid surfaces, Excess pressure inside a liquid drop and a soap bubble, Relation between surface tension and surface energy, Relation between surface Tension, excess pressure & radius of curvature, Determination of surface tension by Jaeger's method, Applications of surface tension with explanation**.**

(09Periods, 12 Marks)

UNIT-IV: FLUID DYNAMICS AND VISCOSITY

General concept of fluid flow, Streamline and turbulent flow, Equation of continuity of flow, Energy possessed by a liquid, Concept of pressure energy, Bernoulli's Theorem and its applications : venturimeter, pitot tube, Definition of viscosity, Flow of a liquid through a capillary: Poiseuille's equation, Experimental determination of coefficient of viscosity by using Poiseuillie's equation.

(12 Periods, 15 Marks)

(TOTAL: 45 Periods, 60 Marks)

REFERENCES:

1) University Physics,Sears and Zeemansky XIth edition, Pearson education.
2) Concepts of Physics, H.C. Varma, Bharati Bhavan Publishers
3) Elements of Properties of Matter : D. S. Mathur, (S. Chand & company, New Delhi).
4) Physics Vol.1 : D. Halliday and R. Resnik.
5) Physics: S. G. Starling (Longman and Green co. Ltd.)
6) Properties of matter: Brij Lal & Subramaniam. N, Eurasia publishing Co., NewDeihi, 1994.
7) University Physics I:J.C.Upadhyaya, Himalaya Publishing House, 2007.

PHY-112: ELECTRICITY AND MAGNETISM

UNIT-I: CURRENT ELECTRICITY

Introduction, Nature of current, current density vector, Resistivity and Conductivity, Microscopic form of ohm's law, Kirchhoff's laws and loop analysis by Kirchhoff's laws, Network theorems:- Thevenin's theorem and Norton's theorem with illustrations, Maximum power transfer theorem (D. C. Source only), Millman's theorem, Electric power, Joule's law.

(15 Periods, 20 marks)

UNIT-II: ELECTRICAL D.C. CIRCUITS

Introduction, Growth and decay of current in circuit containing inductor and resistor, Time-constant of L-R circuit and it's physical significance, Inductive kick and its applications (list only), Charging and discharging of condenser through resistance, Time constant of R-C circuit, Application of R-C circuit as Flasher.

(08 Periods, 10 marks)

UNIT-III: MAGNETIC PROPERTIES OF MATERIALS

Introduction, origin of magnetism, Magnetic parameters, Relation between B, H and M vectors by using solenoid, Types of magnetic materials:-Paramagnetic, Diamagnetic, Ferromagnetic, Antiferromagnetic and Ferrimagnetic materials, Hysteresis, Energy loss due to hysteresis, Soft and Hard magnetic materials, magnets and Types of magnets (Permanent and Electromagnet).

(11 Periods, 14 marks)

UNIT-IV: ELECTROMAGNETIC INDUCTION

Introduction, self and mutual induction, self induction of solenoid, mutual induction of coaxial solenoid, energy stored in inductor, Inductors in series and parallel , Transformer: - Principle, theory of operation, relation between turn ratio, current ratio, voltage ratio and impedance ratio, efficiency of transformer, losses in transformer, Types of transformer:- Closed core transformer, Transformer with tapped secondary, Autotransformer, isolation transformer, Applications of transformers.

(11 Periods, 16 marks)

(TOTAL: 45 Periods, 60 Marks)

References:

1. Foundation of electromagnetic theory: John R. Reitz & Milford
2. Electricity and Magnetism: A. Kip
3. Electricity and Magnetism: D.C.Tayal
4. Principles of electronics: V.K.Mehta
5. Conceptual Physics: Ajit Naik, Jivan Seshan,Taggarase (Himalaya publication)
6. Basic Electronics: B.L.Thereja
7. Electricity and Magnetism: Pricillar W. laws (Willey)
8. Text book of magnetism: R.K.Verma
9. Text book of Electricity D.K.Jha.
10. Classical Electricity and Magnetism:Panofsky &Phillips
11. Electricity and Magnetism with Electronics: Dr. K. K. Tiwari (S. Chand & company, New Delhi).
12. Fundamentals of Magnetism and Electricity: D. N. Vasudewa (S. Chand & company, New Delhi).

PHY 121: HEAT AND THERMODYNAMICS

UNIT-I: EQUATION OF STATE

Andrew's experiment and Amagat's experiment: Discussion on experimental results, Van der Waal's equation, Critical constants, Reduced equation of state, Boyle's temperature.

(12 Periods, 15 Marks)

UNIT-II: BASIC CONCEPTS OF THERMODYNAMICS

Thermodynamic system, Thermodynamic variables, Adiabatic and isothermal changes, Indicator diagram, Work done during an isothermal change, Adiabatic equation of a perfect gas, Work done during an adiabatic change, Thermodynamic equilibrium, Zeroth law of thermodynamics, Concept of internal energy, First law of thermodynamics, reversible and irreversible processes.

(10 Periods, 15 Marks)

UNIT-III: SECOND AND THIRD LAW OF THERMODYNAMICS

Carnot's ideal heat engine, Carnot cycle and its efficiency, Carnot's theorem, Second Law of thermodynamics, Otto and Diesel engines with their efficiencies, Concept of entropy, Change of entropy in reversible process, Change of entropy in Irreversible process, T-S diagram, Third law of thermodynamics, First and Second latent heat equations, variation of boiling and melting points with pressure.

(15 Periods, 20 Marks)

UNIT-IV: ELEMENTS OF REFRIGERATION

Introduction to refrigeration, Basic principles of refrigeration methods, Evaporative refrigeration, Types of vapour refrigeration systems, Basic components and working of simple vapour compression refrigeration system, C.O.P. of refrigerator, Units of refrigeration, Uses of refrigeration. **(8 Periods, 10 Marks)**

(TOTAL: 45 Periods, 60 Marks)

REFERENCES

1. Heat, Thermodynamics and Stastical Physics: Brijlal-Subramanyam (S. Chand, New Delhi).
2. Heat and Thermodynamics: Richard H. Dittman and Mark W. Zemansky
3. Heat and Thermodynamics: V. N. Das
4. Text book of Heat: J. B. Rajam
5. Heat and Thermodynamics: M. S. Yadav
6. Text book of Thermodynamics: D. K. Jha
7. Treatise on Heat: Saha and Srivastav
8. Modern Engineering Physics: A.S. Vasudeva (S. Chand, 4th Ed., 2009)
9. A course in Refrigeration and Air Conditioning: Arora and Domkundwar (Dhanpat Rai & Co., 2002).
10. Refrigeration Engineering: R.C. Patel, B. M. Patel and G.D. Bhat (Acharya Publication,(Baroda)

PHY122: THEORETICAL PHYSICS

UNIT I: COMPLEX ALGEBRA

Introduction to complex numbers, Complex numbers (addition, subtraction, multiplication, division and complex conjugate), Rectangular, Polar and exponential forms of complex numbers (Euler's formula), Argand diagram, Algebra of complex numbers using Argand diagram, De-Moivre's Theorem (Statement only), Powers, roots and log of complex numbers, Trigonometric and hyperbolic functions, Applications of complex numbers to determine velocity and acceleration in circular motion.

(15Periods, 18 Marks)

UNIT II: PARTIAL DIFFERENTIATION

Definition of partial differentiation, Total differential, Exact differential, Chain rule, Theorems of differentiation, Implicit functions, Change of variables from Cartesian to polar co-ordinates, Frequently occurring partial differential equations (Cartesian coordinates), Degree, order, linearity and homogeneity of differential equation.

(8 Periods, 12Marks)

UNIT III: VECTOR ALGEBRA

Introduction to scalars and vectors, Dot product and cross product of two vectors with their properties and physical significance, Scalar triple product with properties and its geometrical interpretation, Vector triple product and its proof.

(07 Periods, 12 Marks)

UNIT IV: VECTOR ANALYSIS

Scalar and vector fields, Differentiation of vectors with respect to scalar, Vector differential operator and Laplacian operator, Gradient of scalar field and its physical significance, Divergence of vector field and its physical significance, Circulation (Curl) of vector field and its physical significance, Some vector identities:

a) $\nabla \times \nabla\phi = 0$
b) $\nabla \cdot (\nabla \times \mathbf{A}) = 0$
c) $\nabla \cdot (\phi \mathbf{A}) = \phi (\nabla \cdot \mathbf{A}) + \mathbf{A} \cdot (\nabla \phi)$
d) $\nabla \times (\phi \mathbf{A}) = \phi (\nabla \times \mathbf{A}) + (\nabla \phi) \times \mathbf{A}$
e) $\nabla \cdot (\mathbf{A} \times \mathbf{B}) = \mathbf{B} \cdot (\nabla \times \mathbf{A}) - \mathbf{A} \cdot (\nabla \times \mathbf{B})$
f) $\nabla \times (\nabla \times \mathbf{A}) = \nabla (\nabla \cdot \mathbf{A}) - \nabla^2 \mathbf{A}$

(15 Periods, 18 Marks)

(Total 45 periods, 60 Marks)

Reference Books:

1. Methods of Mathematical Physics by Laud, Takwale and Gambhir
2. Mathematical Physics by B. D. Gupta
3. Mathematical Physics by Rajput and Gupta
4. Mathematical Methods in Physical Science by Mary and Boas
5. Vector analysis by Spiegel and Murrey
6. Higher Mathematical Physics by H. K. Das (S. Chand, New Delhi).
7. Mathematical Methods for Physicists by Arfken and Weber, 5th Edition, Academic Press.

PHY 113: PRACTICAL COURSE - I

Note: Students should perform at least **eight** experiments from the following list.
Distribution of **60 Marks**: 50 marks for Practical & 10 marks for Journal.

1. Determination of least count of various measuring instruments used in Physics laboratory (At least 5 instruments).
2. M.I. of a disc by torsional pendulum.
3. Determination of acceleration due to gravity by Kater's reversible pendulum.
4. Determination of Y by using flat spiral spring.
5. To determine Y of rectangular beam by bending.
6. To determine the surface tension by Jaeger's method.
7. Determination of coefficient of viscosity of water by Poiseuille's method.
8. Verification of Bernoulli's theorem.
9. Use of analog / digital multimeter.
10. To determine efficiency and turns ratio of transformer.
11. Verification of Kirchhoff's laws.
12. Verification of Thevenin's theorem.
13. Verification of Norton's theorem.

References:

1. Practical Physics by R. K. Shukla, Anchal Srivastava (New Age International).
2. B.Sc. Practical Physics by Harnam Singh and Dr. P.S. Hemne (S. Chand).
3. Advance Practical Physics by S.P.Singh (Pragati).
4. College Practical Physics: Khanna and Gulati (S. Chand and Co. Ltd , Delhi)
5. Practical Physics: Gupta and Kumar (Pragati Prakashan Meerat)
6. Advanced Level Practical Physics: J. M.Nelkon, J.M.Ogloom (EIBS)
7. Advanced Practical .Physics: Worsnop and Flint
8. A Text book of practical Physics: Shrinivasan and Balasubranian
9. A Text book of practical Physics: Indu Prakash and Ramkrishna.
10. B.Sc. Practical Physics by C.L. Arora (S. Chand and Co. Ltd , Delhi)
11. Practical Course in Electronics by Prof. J.R.Patil and other (Jaydeep Prakashan).
12. A text Book of Experimental Physics – Dr. V.Y. Rajopadhye, V.L.Purohit and A.S. Deshpande (Continental Prakashan, Poona-30).

PHY 123: Practical Course – II

Note: Students should perform at least **eight** experiments from the following list.
Distribution of **60 Marks**: 50 marks for Practical & 10 marks for Journal.

1. η by torsional oscillation.
2. Determination of η by using flat spiral spring.
3. To determine Y by vibrational cantilever.
4. Poisson's ratio of rubber by using cord/rubber tube.
5. Thermal conductivity by Lee's method.
6. Thermocouple as thermometer
7. Study of spectrometer and determination of angle of prism.
8. Verification of maximum power transfer theorem.
9. Verification of Joule's law.
10. Determination of time constant of R-C circuit using charging and discharging of condenser through resistor.
11. Determination of time constant of L-R circuit.
12. Electric billing with energy meter.
13. Frequency of a. c. using vibrating wire and magnet.

References:

1. Practical Physics by R. K. Shukla, Anchal Srivastava (New Age International).
2. B.Sc. Practical Physics by Harnam Singh and Dr. P.S. Hemne (S. Chand).
3. Advance Practical Physics by S.P.Singh (Pragati).
4. College Practical Physics: Khanna and Gulati (S. Chand and Co. Ltd , Delhi)
5. Practical Physics: Gupta and Kumar (Pragati Prakashan Meerat)
6. Advanced Level Practical Physics: J. M.Nelkon, J.M.Ogloom (EIBS)
7. Advanced Practical .Physics: Worsnop and Flint
8. A Text book of practical Physics: Shrinivasan and Balasubranian
9. A Text book of practical Physics: Indu Prakash and Ramkrishna.
10. B.Sc. Practical Physics by C.L. Arora (S. Chand and Co. Ltd , Delhi)
11. Practical Course in Electronics by Prof. J.R.Patil and other (Jaydeep Prakashan).
12. A text Book of Experimental Physics – Dr. V.Y. Rajopadhye, V.L.Purohit and A.S. Deshpande (Continental Prakashan, Poona-30).

Equivalent courses of old and new syllabus of F. Y. B. Sc. (Physics)

Old course	Equivalent New course
PHY 111 : Mechanics and Properties of matter	PHY-111: MECHANICS AND PROPERTIES OF MATTER
PHY112 : Electricity and Magnetism	PHY-112: ELECTRICITY AND MAGNETISM
PHY121 : Heat and Thermodynamics	PHY-121: HEAT AND THERMODYNAMICS
PHY122 :Theoretical Physics	PHY-122: THEORETICAL PHYSICS
PHY103:Practical Course	PHY-113: PRACTICAL COURSE – I AND PHY-123: PRACTICAL COURSE - II

CAREER OPPORTUNITIES FOR B. Sc. PHYSICS STUDENTS

B. Sc Physics students can find jobs in public as well as 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.

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 Defence Research and Development Organisation (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.

SCIENCE FACULTY

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SYLLABUS

FOR

S. Y. B. Sc.

PHYSICS

(With effect from June - 2016)

PHY-231: Waves and Oscillations

Unit - I: Composition of two S. H. M.'s

Composition of two S.H.M.s of equal frequencies along same line of vibration (analytical method only), Composition of two S.H.M.s of equal frequencies acting at right angles (analytical method with different cases), Composition of two S.H.M.'s right angles to each other (time period in the ratio 1:2), Lissajous figures- demonstration by mechanical, optical and electrical methods. **(12P, 12M)**

Unit - II: Free and damped oscillations

Undamped free oscillations, Damped free oscillations, Differential equation of damped harmonic oscillator and its solution- discussion of three different cases, Logarithmic decrement, Energy equation of damped harmonic oscillator, Power dissipation, Quality factor, Application to series L-C-R circuit. **(12P, 12M)**

Unit - III: Forced oscillations

Idea of forced oscillations, Resonance and its types- Mechanical resonance (Barton's pendulum), Acoustic resonance (resonance tube), Electrical resonance (LCR circuit) and Optical resonance (sodium vapour lamp), Differential equation of forced oscillations and its solution, Amplitude of forced oscillations, Amplitude resonance, Sharpness of resonance, Velocity Resonance, Energy in forced oscillations, Power dissipation, Band width and quality factor, Application to series L-C-R circuit. **(14P, 14M)**

Unit -IV: Sound

Sound intensity, Loudness, Pitch, Quality and timber, Acoustic intensity level measurement, Acoustic pressure and its measurement. Classification of sound frequencies, Piezoelectric effect, Magnetostriction effect, Generation of ultrasonic waves by Piezoelectric oscillator (using transistor) and Magnetostriction oscillator (using transistor), Detection of ultrasonics waves, Applications of ultrasonic waves (list only). **(12P, 12M)**

Unit -V: Doppler Effect

Doppler effect, Doppler effect in sound, Expression for apparent frequency (different cases when source, observer and medium are in relative motion), Asymmetric nature of Doppler effect in sound, Doppler effect in light, Symmetric nature of Doppler effect in light, Applications of Doppler effect in sound and light. **(10P, 10M)**

Reference Books:

1. Waves and oscillations- Brijlal and Subramaniyam (Vikas Publishing House)
2. Waves and Oscillations- R.N. Chaudhari, New Age International (Pvt.) Ltd.
3. Conceptual Physics- A. P. Taggarase, Jivan Sheshan (Himalaya Publishing).
4. The Physics of Waves and Oscillations- N. K. Bajaj (Tata McGraw Hill).
5. Oscillations and Waves- B. S. Agarwal (KedarNath, Ram Nath Publishers)
6. Sound- Mee and Heinmann, London Edition

PHY- 232 (A): Electronics- I

Unit - I: P-N JUNCTION: P-N junction diode, formation of depletion layer and barrier potential, I-V characteristics of junction diode, reverse saturation current, reverse breakdown (Zener, Avalanche), Zener diode, equivalent circuit of Zener diode, I-V characteristics of Zener diode, Zener diode specifications (P_{Zmax}, I_Z, Rz, Vz), Symbols and Working Principles of LED and Photodiode. **(12P, 12M)**

Unit - II: RECTIFIERS AND FILTERS: Half wave, full wave and bridge rectifiers, ripple factor for half wave, full wave and bridge wave rectifier, filters: capacitance filter, inductor filter and π filter. Concept of voltage regulation, Zener diode as a voltage regulator. **(8P, 8M)**

Unit - III: BIPOLAR JUNCTION TRANSISTOR: Basic construction of bipolar transistors (NPN and PNP), operation of transistor, transistor circuit configurations (CB, CE, CC), current gains (α, and β) and their interrelationship, input and output characteristics of transistor in common emitter configuration. Transistor biasing: Need of biasing, Different Methods of biasing (only listing), Voltage Divider bias method in detail, dc load line and ac load line. **(12P, 12M)**

Unit - IV: TRANSISTOR AMPLIFIER AND OSCILLATOR CIRCUITS: Transistors Amplifier: Single stage R-C coupled common emitter amplifier, its frequency response characteristics and band width.

Sinusoidal Oscillators: Types of feedbacks, Barkhausen Criterion, Oscillatory circuit (tank circuit), Types of Oscillators (List only), Hartley oscillator, Colpitts Oscillator. **(8P, 8M)**

Unit – V : NUMBER SYSTEMS: Decimal number system, Binary number system, Decimal to binary conversion, Binary to decimal conversion, binary arithmetic,1's and 2's complements, hexadecimal number, hexadecimal to decimal conversion, decimal to hexadecimal conversion, Hexadecimal to binary and Binary to hexadecimal conversion, BCD code. **(8P, 8M)**

Unit - VI : DIGITAL CIRCUITS: Positive and negative logic, OR, AND, NOT logic gates using DTL: Symbol, Boolean Expression and Truth Tables, NAND, NOR and Ex-OR gates, De Morgan's theorems, NAND realization of logic gates, R-S, clocked R-S, D , JK and T flip flops using logic gates. **(12P, 12M)**

Total: (60 Periods, 60 Marks)

REFERENCES:

1) Electronic Principles – A. P. Malvino, Mc Graw-Hill Publishing House
2) Electronic fundamentals and applications – J. D. Ryder, Prentice Hall 4th Edition
3) Principles of Electronics – V. K. Mehta, S. Chand Publications, New Delhi
4) Electronic Devices and Circuits – Allen Mottershead, Good year Publishing Company
5) Digital Principles and Applications – Malvino and Leach, Mc Graw-Hill Publication.
6) Modern Digital Electronics – R. P. Jain, Tata Mc Graw-Hill Pvt. Ltd., New Delhi

PHY- 232 (B) - Instrumentation -I

[Note : For students opting electronics as one of the subjects at F. Y. B. Sc. Class]

Unit-I Fundamentals of Measurements :

1.1 : Functional elements of typical measurement system (Block digram only) (R1 : 1.3)

1.2 : Standards of measurements (R1 : 1:6.1) and calibration (R1 : 1:6.2)

1.3 : Static peformance characteristics (R1 : 2.4)

- (a) Accuracy (R1 : 2.4.1)
- (b) Precision (R1 : 2:4.2)
- (c) Accuracy versus precision
- (d) Sensitivity (R1 : 2.4.5)
- (e) Linearity (R1 : 2.4.6)

1.4 : Concept of Errors and their types (R1 : 2.2.1) **(8P, 8M)**

Unit-II Measurement of Temperature :

2.1 : **Non - electrical Methods :**

- (a) Liquid- in-glass Thermometer (R1 : 11.5.2)
- (b) Pressure Thermometer construction and their types (R1 : 11.5.3)
- (i) constant volume gas thermometer and
- (ii) Vapour pressure Thermometer.

2.2 : **Electrical Methods :**

- (a) Metallic resistance Thermometer (Platinum resistance thermometer) (R1 : 11.6.1)
- (b) Semiconductor resistance sensors (Thermistor) (R1 : 11.6.1)
- (c) Thermo-electric Sensors (Thermocouple) (R1 : 11.6.2)

2.3 : **Rediation Methods (Pyrometry) :** (R1 : 11.7) :-

- (a) Total Radiation Pyrometer (R1 : 11.7.1)
- (b) Selective Radiation Pyrometer (R1 : 11.7.2) **(16P, 16M)**

Unit-III: **Measurement of Pressure :**

3.1 : High pressure Measurement (R1 : 10.3)

3.2 : Measurement of low pressure (Vacuum) (R1 : 10.4)

- (a) McLaud Guage
- (b) Pirani Gauge

3.3 : Calibration & Testing (Dead - weight tester) (R1 : 10.5) **(10P, 10M)**

Unit-IV: Measurement of Flow :

4.1 : Classification of flow meters (R2 : 8.2)

4.2 : Expression for rate of flow using Bernoullis theorem (R2 : 8.3)

4.3 : Measurement of flow using :

(a) Venturi tube (R2 : 8.3.2)

(b) Pitot tube (R2 : 8.3.4)

(c) Rotameter (R2 : 8.4) **(10P, 10M)**

Unit-V: Acoustics (Sound) Measurement :

5.1 : Characteristics of sound (R1 : 13.2)

5.2 : Sound pressure level (R1 : 13.3.1)

5.3 : Sound power level (R1 : 13.3.2)

5.4 : Variation of intensity of sound with distance (R1 : 13.3.5)

5.5 : Typical sound measuring system (Sound level Meter) (R1 : 13.5.1)

5.6 : Microphones :

(a) Condenser or capacitor type Microphone (R1 : 13.6.1)

(b) Electret Microphone (R1 : 13.6.2)

(c) Electrodynamic types of Microphone (R1 : 13.6.4)

(d) Carbon granules type Microphone **(12P, 12M)**

Unit-VI: Magnetic Field Measurement :

Measurement of magnetic field by using

(a)search coil method (R3 : 9.9 (a))

(b)Hall gauge meter (R3 : 8.6.11) **(4P, 4M)**

Total : (60 Periods 60 Marks)

Reference Books :

1. R1 : Instrumentation, Measurement & Analysis by (Nakra and Chaudhary), 2nd Edition
2. R2 : Instrumentation : Devices & Systems by (Rangan, Mani & Sarma), 2nd Edition
3. R3 : Electricity and magnetism by D.C.Tayal,3rd Edition
4. R4 : Electricity & Magnetism by Khare & Shrivastav
5. R5 : Modern electronic instrumentation and Measurement Techniques by Helfrick & Cooper.

PHY – 241: Modern Physics

Unit 1: Solar Energy

Energy crisis, conventional and non-conventional energy sources, solar energy option, principle of photothermal conversion, flat-plate collector, liquid flat plate collector: construction, working and energy balance equation only, principle of photovoltaic conversion. solar cell, types of solar cell- Homojuction (PN solar cell), Hetrojunction solar cell (PIN solar cell and MIS solar cell), I-V characteristics of solar cell, Parameters of solar cell, Basic photovoltaic system for power generation, solar cell modules, merits and demerits of photovoltaic solar energy conversion.

(18 P, 18 M)

Unit 2: LASER

Principle of LASER, Characteristics of LASER , Basic staeps required to form a LASER- absorption, spontaneous emission, stimulated emission, Metastable state, population inversion, optical pumping, Types of LASER- Ruby LASER, He-Ne LASER, Applications of LASER (list only), Basic idea of Hologram, construction and reconstruction of Hologram .

(14P, 14M)

Unit 3: 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.

(14 P, 14 M)

Unit 4: Matter Waves

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).

(14 P, 14 M)

Total: (60 Periods, 60 Marks)

REFERENCES-

1. Solar energy utilization - G. D. Rai (Khanna Publisher,Delhi,1996).
2. Non Conventional energy sources- G. D. Rai (Khanna Publisher, Delhi, 2000).
3. Solar Energy- S.P.Sukhtme (Tata MacGraw Hill).
4. Fundamental of Solar Cell- M.A.Green.
5. Solar energy Fundamentals-H.P.Garge (Tata MacGraw Hill)
6. Modern Physics – B.L.Theraja
7. Elementary Modern Physics A.P.Arya
8. Concept of Modern Physics- Aurther Beiser(3^{rd} edition)
9. Modern Physics – D.L.Sehgal,K.L.Chopraand N.K.Sehagal (S.Chand & sons Pub.)
10. An Introduction to Laser – Theory and applications – M.N.Avadhanale
11. Lasers and nonlinear optics – B.B.Laud

PHY-242: Optics

Unit I: Geometrical Optics : Deviation produced by thin lenses, equivalent focal length of two thin lenses separated by a distance and when in contact. Power of lens, Spherical aberration in lens, reduction of spherical aberration (without derivation),Chromatic aberration, Achromatism; (two lenses in contact and separated by finite distance without derivation).

(10P, 10M)

Unit II: Interference: Intensity distribution in the interference pattern, Phase change on reflection (Stoke's treatment only), Interference due to reflected light in parallel sided thin films, Interference in thin wedge shaped film, fringe width in case of fringes of equal thickness. Newton's rings- experimental setup, theory and its application to determine wavelength of source and refractive index of liquids, Michelson Interferometer (experimental setup and its application for measurement of wavelength of monochromatic source)

(18P, 18M)

Unit III: Diffraction: Fresnel and Fraunhoffer diffraction, Fraunhoffer diffraction –Diffraction at single slit and double slits, Theory of plane transmission grating, Intensity distribution in diffraction pattern. Fresnel diffraction, rectilinear propagation of light, Resolving power of grating.

(16P, 16M)

Unit IV: Polarization: Polarization, Polarization by reflection ,Brewster's law, Polarization by double refraction in uniaxial crystals, Maluss Law (Ref. optics by Ajoy Ghatak 4 th edition 22.9) Double refracting crystals, Huygens explanation for normal incidence, Positive and negative crystals, Production and detection of circularly and elliptically polarized light, Construction of Polaroid, Quarter and Half wave plates, Nicol prism, Optical activity, Rotation of the plane of polarization, Specific rotation, Polarimeter or Sacherimeter, (Principle and working).

(16P, 16M)

Total: (60 Periods, 60 Marks)

REFERENCES

1. Optics: N. Subrahmanyam, Brijlal
2. Optics: Jenkins and White .
3. Optics : Singh ,Agrawal
4. Optics : D.S.Mathur.
5. Optics: Ajoy Ghatak.
6. Optics :Eugene Hetch.

PHY 233: PRACTICAL COURSE-I

Note: Students should perform at least **four** experiments from each section

SECTION-I
(GENERAL AND WAVES AND OSCILLATIONS)

1. Determination of the decrement factor by using Logarithmic decrement (in air / water).
2. Study of acoustic resonance by using bottle as a resonator.
3. Determination of velocity of sound by using Kundt's tube.
4. Study of electrical resonance by using series L-C-R circuit.
5. Study of acoustic resonance by using resonance tube.
6. Study of resonance using Kater's pendulum.
7. Comparison of capacities by De Saughty's method.
8. R, Γ, Q using damped harmonic motion.
9. Demonstration of Lissajous figures by using C.R.O.

SECTION-II
(ELECTRONICS)

1. Study of full wave rectifier with capacitor filter and to calculate its ripple factor.
2. Study of zener diode as a voltage regulator.
3. Study of CE transistor characteristics to find out 'β' of the transistor.
4. Study of logic gates (AND, OR and NOT) using diodes and transistors.
5. Verification of De Morgan's Theorems (using ICs).
6. To study the characteristics of Light Emitting Diode (LED).
7. Experimental verification of NAND gate as a universal building block.
8. Experimental verification of NOR gate as a universal building block.
9. To study I – V characteristic of (i) a resistor and (ii) a p–n junction diode and compare it.
10. Frequency response of CE single stage transistor amplifier and to calculate its bandwidth.

OR

SECTION-II
(INSTRUMENTATION-I)

1. 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).
2. To obtain Lissajous figures using C.R.O.
3. To determine characteristics of Thermistor and to find an unknown temperature by using thermistor.
4. Measurement of magnetic field by search coil.
5. Measurement of magnetic field by hall probe method.
6. Directional characteristics of a microphone.
7. Platinum resistance thermometer. (Determine the melting temperature of Wax)
8. Velocity of sound by phase shift method.
9. Measurement of Noise by Using Sound Pressure level Meter.

PHY 243: PRACTICAL COURSE-II

Note: Students should perform at least **four** experiments from each section

SECTION-I
(MODERN PHYSICS)

1. Determination of an electronic charge using PN junction diode.
2. Determination of an energy gap of a 'Ge' semiconductor.
3. I-V characteristics of photocell.
4. Determination of Planck's constant by using Photo cell.
5. To verify Inverse square law of light using a photo cell.
6. Determination of Planck's constant by using LED.
7. Comparison of luminous intensities of two light sources by using photo voltaic cell.
8. Determination of efficiency of a Solar cell.
9. Determination of solar constant.

SECTION-II
(OPTICS AND LASER)

1. Determination of the wavelength of a given source of light using Newton's rings.
2. To determine the refractive index of a liquid by using Newton's rings apparatus.
3. Determination of unknown wavelength of source using diffraction grating.
4. Determination of unknown wavelength of given source by Fresnel's biprism.
5. Measurement of beam divergence of a LASER beam.
6. Measurement of wavelength of a LASER beam.
7. Measurement of beam size of a LASER beam.
8. Determination of specific rotation α of optically active substance using Polarimeter.
9. R. I. of prism.
10. Dispersive power of prism.

References for PHY-233 and PHY-243:

1. A text Book of Experimental Physics – Dr. V.Y. Rajopadhye, V.L.Purohit and A. S. Deshpande (Continental Prakashan, Poona-30).
2. AN ADVANCED COURSE IN PRACTCIAL PHYSICS- D. Chattopadhyay and P.C. Rakshit.
3. Practical Physics by R. K. Shukla, Anchal Srivastava (New Age International).
4. B.Sc. Practical Physics by Harnam Singh and Dr. P.S. Hemne (S. Chand).
5. Advance Practical Physics by S.P.Singh (Pragati).
6. College Practical Physics: Khanna and Gulati (S. Chand and Co. Ltd , Delhi)
7. Practical Physics: Gupta and Kumar (Pragati Prakashan Meerat)
8. Advanced Level Practical Physics: J. M.Nelkon, J.M.Ogloom (EIBS)
9. A Text book of practical Physics: Shrinivasan and Balasubranian
10. A Text book of practical Physics: Indu Prakash and Ramkrishna.
11. B.Sc. Practical Physics by C.L. Arora (S. Chand and Co. Ltd , Delhi)
12. Practical Course in Electronics by Prof. J.R.Patil and other (Jaydeep Prakashan).

List of Equivalent courses for S. Y. B. Sc. (Physics):

Old course		Equivalent new course	
PHY-231	Waves and Oscillations	PHY-231	Waves and Oscillations
PHY-232 (A)	Electronics- I	PHY-232 (A)	Electronics- I
PHY-232 (B)	Instrumentation -I	PHY-232 (B)	Instrumentation -I
PHY-241	Modern Physics	PHY-241	Modern Physics
PHY-242	Optics	PHY-242	Optics
PHY-203	Practical course	PHY-233	Practical course-I
		PHY-243	Practical course-II

SCIENCE FACULTY

NORTH MAHARASHTRA UNIVERSITY, JALGAON

SYLLABUS

FOR

T. Y. B. Sc.

PHYSICS

(With effect from June - 2017)

NORTH MAHARASHTRA UNIVERSITY, JALGAON
Class: T. Y. B. Sc.
Subject: Physics

The revised syllabus for T. Y. B. Sc. Physics prepared by different committees was discussed and finalized in the workshop for T. Y. B. Sc. Syllabi revision on 25th February 2017. The titles of the papers for T. Y. B. Sc. (Physics) are as given below;

Semester	Title of Course	Periods	Marks	
			Ext.	Int.
V	PHY 351: Mathematical Physics	60	60	40
	PHY-352: Classical Mechanics	60	60	40
	PHY- 353: Atomic and Molecular Physics	60	60	40
	PHY: 354(A): Electronics II or PHY-354(B): Instrumentation II	60	60	40
	PHY 355: Solid State Physics	60	60	40
	PHY 356(A): Technical Electronics- I or PHY 356 (B): Refrigeration and Air conditioning- I or PHY 356(C): Vacuum Technology-I or PHY: 356(D): Microprocessor-I or PHY 356(E): Programming in C+ + - I or PHY 356 (F): Solar Energy-I	60	60	40
	PHY 357: Practical Course-I	60	60	40
	PHY 358: Practical Course-II	60	60	40
	PHY 359: Project work-I	60	60	40

Semester	Title of Course	Periods	Marks	
			Ext.	Int.
VI	PHY 361: Classical Electrodynamics	60	60	40
	PHY 362: Quantum Mechanics	60	60	40
	PHY 363: Nuclear Physics	60	60	40
	PHY: 364: Statistical Mechanics and Thermodynamics	60	60	40
	PHY 365: Elements of Material Science	60	60	40
	PHY 366(A): Technical Electronics- II or PHY 366(B): Refrigeration and Air conditioning- II or PHY 366(C): Vacuum Technology-II or PHY: 366(D): Microprocessor-II or PHY 366(E): Programming in C+ + - II or PHY 366 (F): Solar Energy- II	60	60	40
	PHY 367: Practical Course – III	60	60	40
	PHY 368: Practical Course – IV	60	60	40
	PHY 369: Project work- II	60	60	40

Number of teaching days /year	180
Number of teaching days /term	90
Number of periods for theory course or practical course/ week	04

Number of teaching periods /term	52
Number of periods /term for test, seminars and tutorials	08
Total number of periods / term for course	**52 + 08 = 60**

PHY- 351: Mathematical Physics

Unit 1: Vector Analysis

Revision of gradient of scalar, divergence of vector, curl of vector, Gauss divergence theorem, Stoke's theorem, Green's 1st and 2nd theorem, Green's theorem in the plane. (Statements, proofs and problems) **(5P, 6M)**

Unit 2: Curvilinear Co-ordinates

Introduction to Cartesian (X, Y, Z), Spherical polar (r, θ, φ) and Cylindrical (ρ, φ, z) co-ordinate systems and their transformation equations, General Curvilinear Co-ordinate system, coordinate surfaces, length element and volume element, scale factors. Orthogonal Curvilinear Co-ordinates system, Proof of orthogonality of spherical polar and cylindrical co-ordinate systems. Expression for gradient, divergence, curl and Laplacian in spherical, polar and cylindrical co-ordinate systems. **(13P, 16M)**

Unit 3: Differential Equation

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. **(14P, 16M)**

Unit 4: Special Functions

Generating functions for Legendre Polynomial Pn(x), Hermite polynomial Hn(x),and Bessel functions of first kind Jn(x).

Proof of following properties

1) $(n+1)P_{n+1}(x) = (2n+1)xP_n(x) - nP_{n-1}(x)$.
2) $P_n(x) = P'_{n+1}(x) - 2x\,P'_n(x) + P'_{n-1}(x)$.
3) $H_{n+1}(x) = 2xH_n(x) - 2nH_{n-1}(x)$.
4) $H'_n(x) = 2nH_{n-1}(x)$.
5) $J_{n+1}(x) + J_{n-1}(x) = 2n/x\ J_n(x)$.
6) $J_{n-1}(x) - J_{n+1}(x) = 2\,J'_n(x)$. **(9P, 10M)**

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, 12M)**

(Total: 52 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.

PHY- 352: Classical Mechanics

Unit- 1: Introduction to Classical Mechanics

Introduction of classical mechanics,Historical development of classical mechanics, Discussion on Newton's laws of motion, Limitations of Newton's law, Types of forces: Force of gravitation, Lorentz force, Hooks force, Frictional force, Fundamental forces of nature, Projectile motion in various medium, Rocket motion. **(10P, 12M)**

Unit- 2: Motion in Central Force Field

Concept of central force, Properties of central force, Reduction of two body problem into equivalent onebody problem, Motion in central force field, Generalfeatures of motion, Equation of anorbit, Orbits of artificial satellites,Deduction of Kepler's laws of planetary motion.

(14P, 16M)

Unit 3: Lagrangian Formulation

Types of constraints, degrees of freedom, Generalized coordinates, Concept of virtual displacement and virtual work, D'Alemberts principle Lagrange's equation from D'Alembert's principle, Properties of Lagrange's equation, Applications of Lagrange's equation (simple pendulum, linear simple harmonic oscillator, compound pendulum and Atwood'smachine)

(14P, 16M)

Unit 5: Hamiltonian Formulation

Cyclic coordinates, Phase space, Hamiltonian, Hamiltonian's canonical equation of motion, Physicalsignificance of Hamiltonian, Advantages of Hamiltonian approach, Applicationsof Hamilton's equation (simple pendulum, compound pendulum andlinear harmonicoscillator), Poisson Bracket: Definition and Properties. **(14P, 16M)**

(Total: 52 Periods, 60 Marks)

References:

1. Introduction to Classical Mechanics, R. G. Takawale, P. S. Puranik, TMH Publications Ltd.
2. Classical Mechanics, N. C. Rana, P. S. Joag, TMH Publications Ltd.
3. Principles of mechanics, J. L. Synge, B. A. Griffith, TMH Publications Ltd.
4. Classical Mechanics, Herbert Goldstein, Narosa Publishing House
5. Classical Mechanics by J.C. Upadhyaya, Himalaya Publishing House
6. Classical Mechanics: P. V.Panat, NarosaPublishing House
7. Classical Mechanics: Gupta, Kumar and Sharma, Pragati Publication (26^{th} edition)

PHY- 353: Atomic and Molecular Physics

Unit 1: Vector Atom Model

Quantum numbers, physical interpretation of quantum numbers, electron spin, Pauli's exclusion principle, Defination of L-S coupling, spin orbit interaction, spectral terms, selection rules, spectra of single valence electron system (sodium). **(8P, 10M)**

Unit 2: Two Valence Electron System

Spin-spin and orbit-orbit interaction, L-S & j-j coupling schemes, singlet triplet separations, s-p & p-d configuration in L-S coupling and j-j coupling, Lande interval rule. **(12P, 14M)**

Unit 3: Zeeman & Paschen Back effect

Magnetic dipole moment, Larmor precession, Zeeman Effect: Experimental set up, Normal & Anomalous Zeeman Effect for single valence electron system, Lande 'g' factor for single valence electron system (L-S and j- j coupling) for e.g., Helium spectrum, Paschen Back effect for single valence electron system. **(12P, 14M)**

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. **(8P, 10M)**

Unit 5: Molecular spectra

Regions of electromagnetic spectrum, classification of molecular spectra, rotational spectra of diatomic molecule, rotational energy levels of rigid diatomic molecule, vibrational spectra of diatomic molecule, vibrational energy levels of harmonic oscillations. Raman spectra – Experimental set up, explanation of stoke's and anti-stoke's lines. **(12 P, 12M)**

(Total: 52 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.

PHY- 354(A): Electronics- II

Unit 1: Semiconductor 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. **(11P, 12M)**

Unit 2: 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. **(7 P, 8M)**

Unit 3: Differential Amplifier

Introduction, black box concept, basic circuit of differential amplifier, Need of constant current source in differential amplifier, different configurations of differential amplifier, CMRR.

(5P, 6M)

Unit 4: Operational Amplifier and its applications:

Block diagram, 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, frequency response of opamp, Applications : Adder, Substractor, Integrator, Differentiator, Comparator. **(10P, 14M)**

Unit 5: Digital Electronics

a) Counters: Types of counters (Asynchronous and Synchronous), 4-bit Asynchronous down counter (Serial counter), 3-bit Up-down counter, modulus of counter, mod-3 counter, mod-5 counter, and mod 10. **(9P, 8M)**

b) Data Processing circuits:

Multiplexer (2 to 1 & 4 to 1 line), De-multiplexer (1 to 2 & 1 to 4 line), Decoder, Encoder.

(5P, 6M)

c) Timer: - Functional block diagram of IC-555 (Timer), Pin configuration, Astable, Monostable and Bistable multivibrator using IC 555, Application: Square wave Generator **(5P, 6M)**

(Total: 52 Periods, 60 Marks)

References:

1. Principles of Electronics - V. K. Mehta
2. Basic Electronics: B. L. Thereja
3. Electronic Principles - A. P. Malvino
4. Electronic Devices & Circuits - Allen Mottershead
5. Digital Principles and Applications - Leach, Malvino
6. Modern Digital Electronics - R. P. Jain
7. Operational Amplifier - G. B. Clayton
8. Operational Amplifier & Linear Integrated Circuits - R. A. Gaikwad
9. Integrated Circuits - K. R. Botkar

PHY- 354(B): Instrumentation- II

Unit 1: Introduction to Instrumentation

Typical applications of instrument systems, Functional elements of measurement system, Brief description of the functional elements of the instruments-Transducer element, Signal conditioning element, Data presentation element, 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, Dumb and intelligent type.

Definitions: Resolution, Threshold, Range and span, Hysteresis, Dead band, Backlash, Drift, Impedance loading and matching, Selection of the instrument.

Dynamic Characteristics of Instruments: Introduction, Formulation of system equations- Resistance transducer connected to display unit, Thermal element, U-tube manometer. **(14P, 17M)**

Unit 2: Transducer Elements

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, Ionisation transducer, Opto-electric transducer, Digital transducers- Frequency domain transducers, Digital encoders, Optical encoders, Shaft encoder. **(12P, 13M)**

Unit 3: Intermediate Elements

Introduction, Data converters, Digital to analog converters- Binary weighted and R-2R ladder. Analog to digital converters - Successive approximation method, Single and dual slope integration type ADC. Data transmission elements-Electrical-type, Pneumatic-type, Position-type, Radio-Frequency type. **(13P, 15M)**

Unit 4: Data Presentation Elements

Indicating elements- Digital voltmeters, CRO,

Recorders- Strip chart, Galvanometer type, Null-type-Poetntometric, Bridge type, X-Y recorder, Magnetic Recorders, FM recording, Digital data recording.

Display elements- Classification of displays, Display devices- LED, LCD, Gas Discharge Plasma display, Dot matrix display, Electro luminescent display. **(13P, 15M)**

(Total: 52 Periods, 60 Marks)

References:

1. Instrumentation: Measurement and analysis - Nakra and Chaudhary
2. Instrumentation: Device and system - Rangan, Mani, Sharma
3. Electronic Instrumentation and Measurement Techniques - Helfrick and Cooper
4. Electronic Instrumentation – H.S. Kalsi
5. Electrical and Electronic Measurement & Instrumentation - A.K. Sawhney
6. Electronic Measurement- U.A. Bakshi

PHY- 355: Solid State Physics

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. **(12P, 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).

(10P, 12M)

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. **(10P, 10M)**

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. **(10P, 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.

(10P, 12M)

(Total: 52 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

PHY- 356(A): Technical Electronics- I

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 5] **(10P, 12M)**

Unit 2: Optoelectronic Device

LED (Construction, Working & Applications), Multicolour LED, Seven Segment Display, Liquid Crystal Display (LCD), Photodiode (construction, Characteristics & applications), LDR, Introducion to phototransistor. [Ref. 2, 3 & 4] **(10P, 10M)**

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] **(6P, 6M)**

Unit 4: Transducers I

Definition, Classification, Selection of transducer, Electrical transducer: Thermistor, Thermocouple, Pressure Transducer: Strain gauges (wire, foil, & semiconductor), Displacement transducer: LVDT. [Ref. 3, 4 & 10] **(8P, 10M)**

Unit 5: Data Converters

D to A Converters: Resistive divider network, Binary ladder network. A to D Converters: Successive approximation type, Voltage to Time (Single slope, Dual slope), Voltage to Frequency. [Ref. 7 & 8] **(8P, 10M)**

Unit 6: Measuring instruments

Cathode Ray Oscilloscope: Block diagram, Front Panel Control, Dual beam oscilloscope, measurement of voltage, current, frequency, phase using CRO, Function Generator: Block diagram and features, Digital Frequency meter (Frequency mode only): Block diagram & features, Digital Voltmeter (Ramp type only): Block diagram & features. [Ref.3, 4, 6 & 11]

(10P, 12M)

(Total: 52 Periods, 60 Marks)

References:

1. Basic Electronics: B. Grob McGraw Hill Book Co. New York,
2. A Textbook of Applied Electronics – R S Sedha, S Chand & Company, New Delhi.
3. Basic Electronics Solid state - B. L. Thereja, S Chand & Company, New Delhi.
4. Electronic Instrumentation – H S Kalsi, Tata McGraw-Hill Publishing Company Limited, New Delhi.
5. Electronic components and materials: Principles, Manufacture and Maintenance- S. M. Dhir, Tata McGraw-Hill Publishing Company Limited, New Delhi.
6. Measurement and Instrumentation Principles: Alan S. Morris., Butterworth-Heinemann.
7. Transducers and display systems: B. S. Sonde, Tata McGraw-Hill Publishing Company Limited, New Delhi.
8. Digital principles and applications: A.P. Malvino and D. P. Leach. Tata McGraw-Hill.
9. Data Converters– B. S. Sonde, Tata McGraw-Hill Publishing Company Limited, New Delhi.
10. Modern Electronic Instruments and Measurement techniques- Albert D. Helfrick, Willam D. Cooper, Prentice Hall India Pvt. Ltd, New Delhi.
11. A course in electrical and electronic Measurements and Instruments: A. K. Sawhney, Dhanpat Rai and Sons.

PHY- 356(B): Refrigeration and Air conditioning-I

Unit 1: 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) **(8P, 10M)**

Unit 2: 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) **(13P, 16M)**

Unit 3: 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) **(7P, 8M)**

Unit 4: 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) **(14P, 16M)**

Unit 5: Solar refrigeration Systems: 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)

(10P, 10M)

(Total: 52 Periods, 60 Marks)

References:

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.

PHY- 356(C): Vacuum Technology-I

Unit 1: Basics for Vacuum

Atmosphere and Vacuum, Gas pressure, Equations of ideal gas, Fundamental assumption of kinetic theory of gas, Mean free path, Gas diffusion, Viscosity of gas, Thermal conductivity, Adsorption, Absorption, Desorption. **(8P, 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. **(10P, 12M)**

Unit 3: Ultrahigh vacuum pumps

Turbomolecular pump, sorption pump, Ion pump, Getter pump, Cryogenic pump: principle, construction, working, ultimate pressure attainable. **(12P, 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 and Bayard-Alpert gauge. **(12P, 14M)**

(Total: 52 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.

PHY- 356(D): Microprocessor- I

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, Interpreter. **(14P, 18M)**

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. Introduction to 8086(only pin functional diagram). **(12P, 16M)**

Unit-3: Instruction Set of 8085 Microprocessor

Study of addressing mode for 8085:- Implied addressing, Register addressing, Immediate addressing, Direct addressing, Register indirect addressing.

Instruction set:- Data transfer instructions, Arithmetic instructions, Logical instructions, Branching instructions, Stack, I/O and Machine controlled instructions. **(20P, 16M)**

Unit-4: Stack and Subroutines

Stack, subroutine, Restart, conditional call and return instructions. **(6P, 10M)**

(Total: 52 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,

PHY- 356(E): Programming in C+ + - I

Unit 1: Elements of C++

What is C++?, applications of C++ ,comments, I/O streams, structure of C++program. **(6P, 9M)**

Unit 2: Variable & Expressions

Variables, tokens, keywords, identifiers and constants, basic data types, user defined data types & derived data types. Declaration and initialization of variables. **(10P, 11M)**

Unit 3: Operators in C++

Scope resolution operators, member dereferencing operator, memory management operators, manipulators, type cast operator, expressions and their types**.** **(10P, 14M)**

Unit 4: Control structure

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

Loop structures: while, do while, for, nested for loop. **(9P, 10M)**

Unit 5: Functions in C++

Introduction, function prototyping, call by value & call by reference, Inline functions, reference arguments and default arguments. Math library functions. **(11P, 10M)**

Unit 6: Introduction to arrays, structures & union in C++

Definition, declaration, examples. **(6P, 6M)**

(Total: 52 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.

PHY- 356 (F): Solar Energy-I

Unit 1: Introduction

Energy demand and energy resources, Fossil fuels, hydroelectric energy, nuclear energy: Utilization and limitations, Energy Alternatives, Indian energy scenario. **(10P, 12M)**

Unit 2: Solar Energy

Importance of solar energy, Solar radiations: Beam, diffuse and global radiation, characteristics of sun, Solar radiation outside the earth's surface, Solar radiation at the earth's surface. Spectral distribution of extra-terrestrial radiation, Instruments for measuring solar radiation, Pyranometer, Pyrheliometer. **(12P, 12M)**

Unit 3: Thermal Devices

Basic principle, different types of solar collectors, solar dryer, solar pond, solar distillation, solar concentrators: General Characteristics, Definition, Method of classification, Types of Concentrating Collectors Applications of solar concentrating collectors. **(10P, 12M)**

Unit 4: Flat Plate Collector

Construction, principle of operation, transmission of beam and diffuse radiation through the glass cover system, liquid and air flat plate collectors. Materials for flat plate collectors.

(10P, 12M)

Unit 5: Selective Coating

Selective coating, Ideal characteristics of selective coatings for various applications, Types of selective coatings, materials and techniques for making selective absorbers, Effect of elective coating on the efficiency of solar collectors. Production Methods of Coatings (any four).

(10P, 12M)

(Total: 52 Periods, 60 Marks)

References:

1. Solar Engineering and Thermal Processes – Duffie J. and W. Beckman (1991), John Willey and Sons Inc.
2. Solar Energy- Principles of Thermal Collection and Storage- Sukhatme S. P., Second Edition, Tata Mac Graw Hill Co. Ltd.
3. Solar Energy Fundamentals and Applications – Garg H. P. and Satyaprakash (2000), Tata Mc Graw Hill Co. Ltd.
4. Solar Power Engineering – Magal B. S. (1990), Tata Mac Graw Hill Co. Ltd.
5. Renewable Energy Sources and Conversion Technology – Bansal N. K., M. K. M. Meliss (1990), Tata Mac Graw Hill Co. Ltd.

PHY- 357: Practical Course-I

Perform any eight 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. Resolving power of grating.
8. To estimate temperature of Na flame.
9. Measurement of resistivity by four probe method.
10. Frequency of AC/ Tuning fork by stroboscope.
11. Variation of resistance of a filament of a bulb with its temperature.
12. Determination of velocity of sound using ultrasonic Interferometer.
13. Electromagnetic Pendulum.
14. Determination of circular aperture of LASER.

PHY- 358: Practical Course-II

Group A: Perform any four 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.
8. Wien bridge oscillator using IC-741
9. Measurement of self inductance using Maxwell's induction bridge.
10. Binary weighted DAC (R-2R ladder) using OP-AMP

Group B: Perform any four 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. Thermister as a thermometer using IC 741.
3. To study characteristics of LDR.
4. DAC (R- 2R ladder, without OP- AMP).
5. Designing and fabrication of transformer.
6. Triangular, square wave generator using OP AMP.
7. LVDT.
8. V to F converter using IC-741.
9. V to T converter using IC-741.
10. Study of function generator.

B) Refrigeration and Air conditioning:

1. Study of different tools used in Refrigeration & 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 (Vaccu-stat).
5. To calibrate & study the function of Pirani guage.
6. To evacuate a system with a rotary pump (measurement of vacuum with & without ballest using McLeod gauge).

D) Microprocessor:

1. Find square root from look up table.
2. Application of DAC (square/triangular sweep wave).
3. Up-down counter (4-bit).
4. Hexadecimal/decimal counter.
5. Multiplexer/Demultiplexer using IC.
6. Interfacing of thumbwheel switch.

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 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 use of inline function for finding 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 upto 20 terms
   e.g. 1,1,2,3,5,8,…… (20 terms)
8. Write a C++ program to create following structure
   Roll-No. Stud-Name Class
   Enter at least five records

F) Solar Energy:

1. Study of Power versus load characteristics of Solar Photovoltaic panel
2. Study of Series combination of Solar Photovoltaic panels
3. Study of Parallel combination of Solar Photovoltaic panels
4. Study of Solar Lantern/ Street light
5. Determination of Calorific value of Coal/Cow dung

PHY- 359: Project – I

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.

The student will have to give a seminar on the above topics.

The student must perform his project presentation by PPT on LCD projector.

PHY- 361: Classical Electrodynamics

Unit 1: Electrostatics

(Revision- Electrical charge, Coulomb's law, Electric field, Electrostatic potential), Principle of superposition, continuous charge distribution, Linear, surface and volume charge density, Flux of an electric field, statement of Gauss's law. Differential form of Gauss's law, Applications of Gauss's law- i) Electrical field outside the charged sphere ii) Electric field inside charged sphere iii) Electric field due to infinite sheet of charge. Electric dipole, Expression for potential and intensity. **(10 P, 12 M)**

Unit 2: Electrostatic field in dielectrics

Dielectric materials, polar and non polar molecules, polarization vector, Electric field vector at exterior point of dielectric medium, Electric displacement vector $\vec{D}$, Susceptibility, Permittivity, Dielectric constant, Relation between $\vec{D}, \vec{E}$ and $\vec{P}$, Boundary condition for $\vec{E}$ and $\vec{D}$, Dielectric sphere in uniform electric field, The method of electrical image for grounded plane and grounded conducting sphere (point charge near a grounded charged sphere, potential and intensity at a point M(r, θ). **(12 P, 16 M)**

Unit 3 Magnetostatics

Current density (J), Equation of continuity, Magnetic induction, Lorentz force on a point charge moving in a magnetic field, Biot and Savart's law, Magnetic induction due to a current flowing in a long straight wire, Magnetic induction due to a current carrying circular loop, Axial magnetic field of a solenoid, Magnetic forces between two current carrying loops, Ampere's circuital law and its applications for long cylindrical current carrying wire, co-axial cable. Magnetic vector potential $\vec{A}, \vec{B}, \vec{M}$ and $\vec{H}$, and relation between them, Magnetic susceptibility and permeability, Boundary conditions for $\vec{B}$ and $\vec{H}$. **(16 P, 16 M)**

Unit 4: Electrodynamics

Electromagnetic field, Faraday's law of induction in differential and integral form. Modified Ampere's law, Maxwell's equation in differential and integral form. Electromagnetic waves – solution of a plane wave in free space. Poynting vector in free space and electromagnetic energy. Reflection and refraction of a plane wave from non-conducting boundaries (Normal incidence only). **(14 P, 16 M)**

(Total: 52 Periods, 60 Marks)

References:

1) Electrodynamics: Dr. S. L. Gupta, Dr. V. Kumar, Dr. S.P. Singh, Pragati Prakashan (19th Edition, 2007).

2) Electromagnetic: B. B. Laud, Wiley aster Ltd., New Delhi (2nd Edition).

3) Foundation of Electromagnetic field: John R. Reitz and Fredrick J., Narossa Publishing House, New Delhi (3rd Edition).

4) Fundamental Electricity and magnetism: F. Kip, Mc Graw hill Kogakusha Ltd. (2nd Edition).

5) A text book of Classical Electrodynamics: Prof. M. K. Yeole, Dr. R.T. Chaudhari.

PHY- 362: Quantum Mechanics

Unit 1: The Schrodinger Equation

Wave function and its Physical interpretation, normalized and orthogonal wave functions, Formulation of time dependent and time independent Schrödinger equation (Steady state equation), Requirements of wave equation, Probability current density and equation of continuity, Solution of Schrodinger's equation, Energy eigen values and eigen functions, Expectation value – Ehrenfest's theorem. (Ref:1 & 2) **(14P, 14M)**

Unit 2: Applications of Schrödinger steady state equation

Particle in a rigid box (derivation of energy Eigen value and eigen functions), Particle in a non-rigid box, Step potential (Probability of reflection (R) and transmission (T)), Harmonic oscillator (one dimension). (Ref: 2,6,7) **(16P, 16M)**

Unit 3: Quantum theory of Hydrogen atom

Schrödinger equation in spherical polar co-ordinate system, Hydrogen atom-Solutions of R,Θ,Φ equations, Quantum numbers n, l m_l amd m_s. (Ref: 1) **(10P, 14M)**

Unit 4: Operators in Quantum

Hermitian operator, Position, Momentum operator, angular momentum operator, and total energy operator (Hamiltonian), Commutator brackets, 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, Raising and lowering angular momentum operator, Concept of parity, parity operator and its Eigen values.(Ref: 2 & 4)

(12P, 16M)

(Total: 52 Periods, 60 Marks)

References:

1. Perspectives of Modern physics : Arthur Beiser
2. Advance Quantum Mechanics: Satya Prakash, Kedarnath Ran 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

PHY- 363: Nuclear Physics

Unit 1: Nucleus and Nuclear Forces

Nuclear compositions:- Constituents, charge, size, density, atomic mass of nucleus, nuclear magnetic moment, parity, 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). **(10P, 12M)**

Unit 2: Radioactivity

Law of radioactive decay, half life, mean life, specific activity, partial radioactive decay, successive disintegration, Applications of radioactivity (Agricultural, Biological, Medical and industrial), Problems. **(07P, 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**.** **(08P, 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. **(08P, 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, Breeder reactor, Problems. **(12P, 14M)**

Unit 6: Nuclear Detectors and Accelerators

Types of detectors, Geiger-Mueller counter, Scintillation counter, Classification of accelerators**:** Cyclotron and Betatron.

(07P, 08M)

(Total: 52 Periods, 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. Nuclear Physics: D.G. Tayal.
6. Concepts of Modern Physics – Arthur Beiser (5th Edition).
7. Atomic Physics: J.B. Rajam.
8. Introduction to Nuclear Physics: H.A. Enge (Addition Wesely Co.)

PHY- 364: Statistical Mechanics & Thermodynamics

Unit 1: Probability Distribution

Introduction to Statistical Mechanics, Basic concepts of probability, Probability distribution, Binomial distribution, Random walk problem in one dimension, Calculation of mean values for random walk problem, Probability distribution for large scale-N, Gaussian probability distribution. **(10P, 12M)**

Unit 2: Statistical Formulation

Specification of the state of the system, Macroscopic & Microscopic states, Statistical Ensembles and their classification, Phase Space, Volume in phase space, Division of phase space into cells, Accessible states, Postulate of equal a priori probability, Behaviour of density of states, Calculation of microstates of an ideal monatomic gas, Thermal and mechanical interactions.

(10 P, 12M)

Unit 3: Statistical Thermodynamics

Thermodynamic equilibrium, Constraints, Equilibrium conditions and constraints, Distribution of energy between systems in equilibrium, Boltzmann relation for entropy, Accessible states and first law of thermodynamics, Statistical calculations of thermodynamic quantities. **(08P, 10M)**

Unit 4: Ensembles and Partition function

Probability distribution for canonical ensembles, Applications of canonical distribution such as Curie's law of Paramagnetism & Maxwell's law of velocity distribution, system with mean specified energy, Calculation of mean values in canonical distribution, Partition function and its connection to free energy, Properties of partition function, Partition function of an ideal gas, Equipartition theorem. **(14P, 14M)**

Unit 5: Thermodynamics

Thermodynamic potentials, Maxwell's relations from thermodynamic potentials, First and second TdS equations, Ratio and difference of two specific heats, Energy equation, Joule Thomson effect (Throttling process). **(10P, 12M)**

(Total: 52 Periods, 60 Marks)

References:

1. Fundamental of Statistical & Thermal Physics: F. Reif (McGraw Hill)
2. Statistical and thermal physics: Lokanathan and Gambhir
3. Thermodynamics & Statistical Physics : Sharma & Sarkar (Himalaya Publishing House)
4. Fundamentals of Statistical Mechanics: B.B. Laud (New Age International Publishers)
5. Heat & Thermodynamics: M.W. Zemansky.
6. Statistical Mechanics: Gupta and Kumar

PHY- 365: Elements of Material Science

Unit 1: Introduction to materials

Classification of materials, Advanced materials, Materials of the future (Smart materials and Nano Materials)

Organic Materials (Polymers): Properties of polymer, Polymerization, Degree of polymerization, Linear polymers and their types, Vulcanization of rubber, Molecular weight, Molecular structure, Thermoplastic & Thermosetting Polymers. Advanced polymeric materials, Polymers additives.

(10P, 14M)

Unit 2: Properties of Materials

Mechanical Properties: Stress, strain (tensile, compressive and shear), strength, elasticity, plasticity, ductility, malleability, hardness, toughness, creep, fatigue, stiffness, Isotropy, Anisotropy, factor affecting the mechanical properties, (Grain size, temperature, exposure to atmosphere, Heat treatment and Carbon content).

Thermal Properties: Heat capacity, Thermal expansion, Thermal conductivity.

Electrical Properties: Conductivity, resistivity, dielectric strength, piezoelectricity. **(12P, 14M)**

Unit 3: Atomic disorder in materials

Solid solution: Types of solid solution (Interstitial and substitutional solid solution), Rules of solid solubility.

Imperfections (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. **(12P, 14M)**

Unit 4: Diffusion of solid material

Atomic diffusion- Definition, Mechanism (Interstitial, vacancy diffusion), self diffusion in nickel, diffusivity, Fick's first law of diffusion, Fick's second law of diffusion, variation of diffusivity with temperature, factor that influence diffusion. **(08P, 08M)**

Unit 5: Phase Diagram

Phase diagram, Phase equilibrium, Construction 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, Construction of phase diagram, Eulectic reaction, lever rule, Pb-Sn phase diagram**.** **(10P, 10M)**

(Total: Periods 52, Marks 60)

References:

1. Materials Science & Engineering An Introduction (6th Edition): By William D. Callister Wiley Student Edition, India.
2. Elements of Materials Science & Engineering: Van Vlack
3. First Course in Materials Science & Engineering: Raghavan.
4. Material Science: S. L. Kakani, Amit Kakani. New Age International Publishers

PHY- 366(A): Technical Electronics- II

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]. **(12P, 12M)**

Unit 2: Public address system

Block diagram of 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] **(8P, 8M)**

Unit 4: Transducer II

Peizo-electric Transducer, Optoelectronic transducers: LDR, Chemical sensors: PH sensor, Gas sensor (Fundamental aspects), Humidity sensor (Resistive). [R7, R8]. **(10P, 12M)**

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 machine: Principle, Block diagram, features.

Electronic Weighing Systems - Operating principle, Block diagram, features. **(12P, 14M)**

(Total: 52 Periods, 60 Marks)

References:

1. Audio and Video Engineering System: R.G. Gupta, Tata McGraw-Hill Publishing Company Ltd, New Delhi.
2. Basic Electronics --B. L. Thereja
3. Introduction to Bio-medical Electronics: Joseph-Du-bary, McGraw Hill Co. Ltd.
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.

PHY- 366(B): Refrigeration and Air conditioning-II

Unit 1: Introduction to air conditioning:
Meaning of air conditioning, Five main factors of comfort air conditioning, Introduction to Heat Transfer Introduction, Conduction through slab, pipe, hollow sphere, Convection, Heat transfer by convection, combined conduction and convection heat transfer, Fins and their applications. (Ref. 1: Chapter -15) **(8P, 8M)**

Unit 2: 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 outdoor conditions, Summer air conditioning with evaporative cooling, Winter air conditioning system for mild cold weather. (Ref. 1: Chapter -16) **(12P, 14M)**

Unit 3: 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) **(8P, 10M)**

Unit 4: Air Conditioning equipments Air Filters: Functions, Types, Wet filters, Electronic filters, 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, Dehumidifying air washers. Fans & Blowers: Functions, Axial flow fans, Centrifugal fans. Grills and Registers. (Ref. 1: Chapter -25) **(14P, 16M)**

Unit 5: 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 humidostat, Absorption type thermostat, Water vapour recorder. Actuators: Relays Introduction to Transmission systems. Pre heat and humidification control systems, Cooling dehumidification and reheat control, Face and bypass control system. (Ref. 1: Chapter -26) **(10P, 12M)**

(Total: 52 Periods, 60 Marks)

References:

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

PHY- 366(C): Vacuum Technology-II

Unit 1: Vacuum materials and components

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. **(9P, 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. **(9P, 10M)**

(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. **(9P, 12M)**

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. **(12P, 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. **(9P, 10M)**

Unit 4: Application of Vacuum Technology

Applications of Vacuum technology in Research and Industry. **(4P, 6M)**

(Total: 52 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.

PHY- 366(D): Microprocessor- II

Unit 1: Assembly Language Programming

Arithmetic programs: 8- bit addition, 8- bit subtraction, Decimal addition and decimal subtraction of two 8 bit numbers, 8- bit multiplication, One's and two's complement of 16- bit numbers, Find largest and smallest numbers from a series of given number, Masking of 4- MSB 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. **(16P, 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. **(12P, 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**.** **(12P, 14M)**

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, Reading while counting operation- MODE 0, MODE 1, MODE 2, MODE 3, MODE 4 and MODE 5. **(12P, 14M)**

(Total: 52 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.

PHY- 366(E): Programming in C+ + - II

Unit 1: Objects & Classes

Simple classes (class specification, C++ objects, accessing class members), constructors and destructors, constant member functions. **(7P, 9M)**

Unit 2: Functions and operator overloading

Overloading functions, introduction to operating overloading, overloading unary and binary operators, overloading arithmetic assignment operator. **(12P,12M)**

Unit 3: Inheritance

Derived class and base class, derived class constructors, public and private inheritance, multiple inheritance, hierarchical inheritance, multilevel inheritance, containership (classes within classes). **(12P, 12M)**

Unit 4: Virtual functions

Virtual functions, pure virtual functions, friend functions, Static functions, copy constructor, this pointer. **(7P, 9M)**

Unit 5: Generic programming

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

(6P, 8M)

Unit 6: File and streams

Input/Output streams, classes for steam operation, opening and closing files, file pointers and their manipulations, error handling during file operations. **(8P, 10M)**

(Total: 52 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.

PHY- 366(F): Solar Energy- II

Unit 1: Introduction

Fundamentals of photovoltaic energy conversion, Principle, & Construction of solar cell and its working principle, Materials for solar cells, Criteria for choice of Materials for Solar cell , Types of solar cells , Applications of solar cell, Advantages and Disadvantages of solar cell.

(10P, 12M)

Unit 2: Review of Semiconductor Properties

Introduction, crystal structure and orientations, forbidden energy gaps, probability of occupation of allowed states, dynamics of electrons and holes, energy density of allowed states, Bond model of group IV semiconductor, group III and group V dopants, carrier densities, location of Fermi level in doped semiconductors. **(12P, 12M)**

Unit 3: P N Junction Diodes

Introduction, electrostatics of p-n junction, junction capacitance, carrier injection, dark characteristics, illuminated characteristics, solar cell output parameters. **(10P, 12M)**

Unit 4: Efficiency Limits, Losses and Measurement

Introduction, efficiency limits: general, short circuit current, open circuit voltage and efficiency, efficiency limits for black body cell, effect of temperature, efficiency losses: general, short circuit current losses, open circuit current losses, efficiency measurement. **(10P, 12M)**

Unit 5: Photovoltaic Systems: Components And Applications

Introduction, Basic Photovoltaic system for power generation, energy storage: electro chemical batteries, large capacity approaches, Power conditioning equipments, Photovoltaic (PV) systems and their types, photovoltaic applications. **(10P, 12M)**

(Total: 52 Periods, 60 Marks)

References:

1. Solar Cells Operating Principles, Technology and System Applications – Martin A. Green, University of New Wales, Australia.
2. Solar Energy- Principles of Thermal Collection and Storage- Sukhatme S. P., Second Edition, Tata Mc Graw Hill Co. Ltd.
3. Solar Energy Fundamentals and Applications – Garg H. P. and Satyaprakash (2000) Tata Mc Graw Hill Co. Ltd.
4. Solar Energy Utilisation – G. D. Rai, (2004), Khanna Publishers.
5. Solar Thermal Engineering – Duffie J. A.

PHY- 367: Practical Course-III

Perform any eight experiments:

1. Surface tension by Quinke's method.
2. Surface tension by soap bubble method.
3. Thermal conductivity of rubber by tubing method.
4. Thermal conductivity of metal by Forbe's method.
5. Verification of certain laws of probability distribution.
6. Verification of Stefan's law by torch bulb filament.
7. Characteristics of G.M. counter.
8. Diffraction by straight edge/cylindrical obstacle.
9. e/m using Thomson's method.
10. Verification of Clausius-Clapeyron's latent heat equation
11. Jolly's steam calorimeter.
12. Study of directional characteristics of unidirectional microphone.
13. Velocity of sound by phase shift method.
14. Viscosity by rotating cylinder method.
15. Determination of 'g' by conical pendulum.
16. Study of oscillatory charge and discharge through an inductance and resistance.

PHY- 368: Practical Course-IV

Group A: Perform any four experiments (Material Science, Thermodynamics,Electronics):

1. Determination of curie temperature of Ferrite.
2. 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. Core losses in transformers.
8. IC 723 as regulated power supply.
9. Study of IC 7490 as mod 2, mod 5 and mod 10 counter.

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

A) Technical Electronics:

1. Half wave precision rectifier using OP AMP.
2. Full wave precision rectifier using OP AMP.
3. Study of P. A. system (series and parallel connection of two speakers) and measurement of equivalence resistance.
4. Study of OP AMP as an adder.
5. Study of OP AMP as substractor.
6. Study of OP- AMP as a differentiator.
7. Study of OP- AMP as an integrator.
8. Frequency response of loudspeaker (twitter, woofer, mid-range).
9. Study of E.C.G.

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 pumpingmodule with the pressure in vacuum system.

D) Microprocessor:

1. 8-bit decimal addition/subtraction.
2. Find largest/smallest number from series of 8-bit numbers.
3. Conversion of Hex to ASCII code.
4. 8-bit binary multiplication.
5. LED interface (Time delay generation).
6. Study of shift register (using IC).

E) Programming in C++:

1. Write a C++ program to implement string operations
   i) strlen( )
   ii) strcat( ) as class membersWrite 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 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 inheritance.
7. Write a C++ program to implement virtual functions.
8. Write a C++ program to demonstrate use of function templates

F) Solar Energy:

1. Study of Solar Box Cooker: Evaluation of F1 and F2.
2. Study of Solar still for Water distillation.
3. Study of Solar Hot water system.
4. Study of Concentrating type Solar Cooker – SK 14.
5. Study of Solar Dryer: Hot air collector.

PHY- 369: Project work – II

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.
2. Characterize the samples, if any.
3. Discussion of the results.
4. Conclusions.

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.

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 Defence Research and Development Organisation (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 Defence Services Exams conducted for recruiting candidates to various posts in Defence Department.

Equivalent courses:

Semester	Course Title (Old)	Semester	Course Title (New)
V	PHY-351: Mathematical Physics	V	PHY-351: Mathematical Physics
	PHY-352: Classical Mechanics		PHY-352: Classical Mechanics
	PHY-353: Atomic and Molecular Physics		PHY-353: Atomic and Molecular Physics
	PHY-354 (A): Electronics II OR		PHY-354 (A): Electronics II OR
	PHY-354 (B): Instrumentation II		PHY-354 (B): Instrumentation II
	PHY-355: Solid State Physics		PHY-355: Solid State Physics
	PHY-356 (A): Technical Electronics- I OR		PHY-356 (A): Technical Electronics- I OR
	PHY-356 (B): Refrigeration and air conditioning-I OR		PHY-356 (B): Refrigeration and air conditioning-I OR
	PHY-356 (C): Vacuum Technology-I OR		PHY-356 (C): Vacuum Technology-I OR
	PHY-356 (D): Microprocessor- I OR		PHY-356 (D): Microprocessor- I OR
	PHY-356 (E): Programming in C+ + - I OR		PHY-356 (E): Programming in C+ + - I OR
	PHY-356 (F): Solar Energy - I		PHY-356 (F): Solar Energy - I
VI	PHY-361: Classical Electrodynamics	VI	PHY-361: Classical Electrodynamics
	PHY-362: Quantum Mechanics		PHY-362: Quantum Mechanics
	PHY-363: Nuclear Physics		PHY-363: Nuclear Physics
	PHY-364: Statistical Mechanics and Thermodynamics		PHY-364: Statistical Mechanics and Thermodynamics
	PHY-365: Elements of Material Science		PHY-365: Elements of Material Science
	PHY-366 (A): Technical Electronics- II OR		PHY-366 (A): Technical Electronics- II OR
	PHY-366 (B): Refrigeration and air conditioning-II OR		PHY-366 (B): Refrigeration and air conditioning-II OR
	PHY-366 (C): Vacuum Technology-II OR		PHY-366 (C): Vacuum Technology-II OR
	PHY-366 (D): Microprocessor- II OR		PHY-366 (D): Microprocessor- II OR
	PHY-366 (E): Programming in C+ + - II OR		PHY-366 (E): Programming in C+ + - II OR
	PHY-366 (F): Solar Energy - II		PHY-366 (F): Solar Energy - II
V and VI	PHY-307: Practical Course-I	V	PHY- 357: Practical Course-I
		VI	PHY- 367: Practical Course-III
V and VI	PHY-308: Practical Course-II	V	PHY- 358: Practical Course-II
		VI	PHY- 368: Practical Course-IV
V and VI	PHY-309: Project	V	PHY-359: Project work-I
		VI	PHY-369: Project work-II

FACULTY OF SCIENCE & TECHNOLOGY

NORTH MAHARASHTRA UNIVERSITY, JALGAON

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

SYLLABUS

FOR

F. Y. B. Sc. (PHYSICS)

(AS PER CHOICE BASED CREDIT SYSTEM PATTERN OF UGC)

(With effect from June - 2018)

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 & 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, NMU, Jalgaon is going to implement the Choice Based Credit (CBCS) pattern to undergraduate program run by various colleges affiliated to NMU, Jalgaon. As per the initiatives led by the Honorable Vice Chancellor, Pro-Vice Chancellor and Dean of the Faculty of Science and Technology of our university, one day workshop were organized for syllabus framing and teachers of the affiliated colleges and university department were participated in workshop of re-structuring the syllabi of F.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 2018-19. The main objective of the re-structuring the syllabi of F.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 studying physics will apply investigations and problem solving skills, effectively communicate the theoretical concepts, and appreciate the contribution that the study of physics makes to our understanding of 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 Mechanics, electricity and magnetism, electrostatics and mathematical physics;
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 backgrounds.

NORTH MAHARASHTRA UNIVERSITY, JALGAON

Class: **F. Y. B. Sc.**

Subject: **Physics**

Choice Base Credit System (With effect from June 2018)

The Board of Studies in Physics in its meeting held on **4th July 2018**has unanimouslyaccepted the revised syllabus (as per CBCS pattern) prepared by different committees, discussed and finalized inworkshop for F.Y.B.Sc. Syllabi revision. The titles of the papers for F.Y.B.Sc. (Physics) areas given below;

Semester	Course as per UGC	Core Course		No of Credits	Hours/ Semester	Marks	
		Course Code	Course Title			Int.	Ext.
I	PHYSICS-DSC 1A: MECHANICS (Credits: Theory-04, Practicals-02) PHYSICS LAB	PHY-101	Basic Mechanics	2	30	40	60
		PHY-102	Dynamics and Elasticity	2	30	40	60
		PHY-103	LAB -I	2	60	40	60
II	PHYSICS-DSC 2A: ELECTRICITY AND MAGNETISM (Credits: Theory-04, Practicals-02) PHYSICS LAB	Course Code	Course Title	No of Credits	Hours/ Semester	Marks	
						Int.	Int.
		PHY-201	Electricity and Electrostatics	2	30	40	60
		PHY-202	Magnetism and Electromagnetism	2	30	40	60
		PHY-203	LAB -II	2	60	40	60

Note:

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

NORTH MAHARASHTRA UNIVERSITY, JALGAON

Syllabus of F. Y. B. Sc. Physics

(Choice Based Credit System)

Semester I

PHYSICS-DSC 1 A: MECHANICS

Theory: 60 Lectures

Course description:

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

Course objectives:

1. To impart knowledge of basic concepts in basic 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 of use of knowledge of mechanics to real life problems.
2. Understanding of the course will create scientific temperament.

PHY 101: BASIC MECHANICS (30 Lectures)

(Credits: Theory-04, Practicals-02)

Course Content

1. **Vectors:** Vector algebra, Scalar and vector products, Derivatives of a vector with respect to a parameter. **(04 Lectures, 12 Marks)**
2. **Ordinary Differential Equations:**Types of differential equations, degree and order of differential equation (definitions only), linear and non-linear differential equations (definitions only), homogeneous and non-homogeneous differential equations (definitions only)1^{st} order homogeneous differential equations, 2^{nd} order homogeneous differential equations with constant coefficients (definitions with examples). **(08 Lectures, 16 Marks)**
3. **Laws of Motion:** Frames of reference, Newton's Laws of motion, Dynamics of a system of particles, Centre of Mass. **(10 Lectures, 16 Marks)**
4. **Momentum and Energy:** Conservation of momentum, Work and energy, Conservation of energy, Motion of rockets. **(04 Lectures, 08 Marks)**
5. **Rotational Motion:** Angular velocity and angular momentum, Torque, Conservation of angular momentum. **(04 Lectures, 08 Marks)**

PHY 102: DYNAMICS AND ELASTICITY (30 Lectures)

1. **Gravitation:** Newton's Law of Gravitation, Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant), Kepler's Laws (statement only), satellite in circular orbit and applications, Geosynchronous orbits, Weightlessness, Basic idea of global positioning system (GPS).**(08 Lectures, 16 Marks)**
2. **Oscillations:** Simple harmonic motion, Differential equation of SHM and its solutions, Kinetic and Potential Energy, Total Energy and their time averages, Damped oscillations. **(07 Lectures, 14 Marks)**
3. **Elasticity:** Hooke's law, Stress-strain diagram, Elastic moduli, Relation between elastic constants, Poisson's Ratio, Expression for Poisson's ratio in terms of elastic constants, Work done in stretching and work done in twisting a wire, Twisting couple on a cylinder, Determination of Rigidity modulus by static torsion, Torsional pendulum, Determination of Rigidity modulus and moment of inertia - q, η and σ by Searles method. **(08 Lectures, 16 Marks)**
4. **Viscosity:** Introduction, definition of viscosity, general concept of fluid flow, Streamline and turbulent flow, Energy possessed by a liquid and Bernoulli'sTheoremand its application: venturimeter,Rate flow of liquid in a capillary tube-Poiseuille's formula, determination of coefficient of viscosity of a liquid by using Poiseuillie's equation, variations of viscosity of a liquid with temperature.

(07 Lectures, 14 Marks)

Note: *Students are not familiar with vector calculus. Hence all examples involve differentiation either in one dimension or with respect to the radial coordinate*.

Reference Books:

1. University Physics. FW Sears, MW Zemansky and HD Young13/e, 1986. Addison-Wesley
2. Mechanics Berkeley Physics course, V-1: Charles Kittel, et. al. 2007, Tata McGraw-Hill.
3. Physics: Resnick, Halliday & Walker 9/e, 2010, Wiley
4. Engineering Mechanics, Basudeb Bhattacharya, 2nd edn., 2015, Oxford University Press

5. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
6. Elements of Properties of Matter –D. S. Mathur, Shamlal Charitable trust, New Delhi.

PHYSICS LAB: DSC 1A LAB: MECHANICS (60 lectures)

PHY 103: LAB-I

(Students should perform at least **ten**experiments from the following list)

1. Calculation of errors from given data.
2. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
3. To determine the Height of a Building using a Sextant.
4. To determine the Moment of Inertia of a Flywheel.
5. To determine the Young's Modulus of a Wire by Optical Lever Method.
6. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
7. To determine the Elastic Constants of a Wire by Searle's method.
8. To determine 'g' by Bar Pendulum.
9. To determine 'g' by Kater's Pendulum.
10. To determine 'g' and velocity for a freely falling body using Digital Timing Technique
11. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of 'g'
12. To determine the Moment of Inertia of a Disc.
13. To determine Y by using flat spiral spring.
14. To determine Y of a rectangular beam by bending.
15. To determine η by using flat spiral spring.
16. To determine η by torsional oscillations.
17. To determine Y by vibrational cantilever.
18. To determine Poisson's Ratio of rubber by using rubber cord/tube.
19. Determination of coefficient of viscosity of water by Poiseuille's method.
20. Verification of Bernoulli's theorem.

Reference Books:

1. Advanced Practical Physics for students, B.L.Flint and H.T.Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4thEdition, reprinted 1985, Heinemann Educational Publishers.
3. Engineering Practical Physics, S.Panigrahi&B.Mallick, 2015, Cengage Learning India Pvt. Ltd.
4. A Text Book of Practical Physics, InduPrakash and Ramakrishna, 11th Edition,2011, KitabMahal, New Delhi.
5. A text Book of Experimental Physics-Dr. V.Y. Rajopadhye, V.L.Purohit and A.S. Deshpande (Continental Prakashan, Poona-30)
6. Practical Physics by R. K. Shukla, AnchalSrivastava (New Age International).
7. Advance Practical Physics by S.P.Singh (Pragati).
8. Practical Physics: Gupta and Kumar (PragatiPrakashan Meerut)
9. University Practical Physics by D. C. Tayal, Himalaya Publishing House.

Semester II

PHYSICS-DSC 2A: ELECTRICITY AND MAGNETISM
Theory: 60 Lectures

Course description:
This course is aimed at introducing the fundamentals of Electricity and Magnetism to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Electricity and Magnetism.
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 Electricity and Magnetism to real life problems.
2. Understanding of the course will create scientific temperament.

(Credits: Theory-04, Practicals-02)

PHY 201: ELECTRICITY AND ELECTROSTATICS (30 Lectures)

1. **Vector Analysis**: Review of vector algebra (Scalar and Vector product), gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume, integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors (statement only). **(10 Lectures, 20 Marks)**
2. **Network theorems in current electricity:** Kirchhoff's laws and loop analysis by Kirchhoff's laws, Network theorems: Thevenin's theorem and Norton's theorem with illustrations, Maximum power transfer theorem (D. C. Source only), Electric power, Electricity bill calculation, Joule's law. (**10 Lectures, 20 Marks)**
3. **Electrostatics:** Electrostatic Field, electric flux, Gauss's theorem of electrostatics, Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential. **(10 Lectures, 20 Marks)**

PHY 202: DIELECTRICS, MAGNETISM AND ELECTROMAGNETISM

(30 Lectures)

1. **Capacitance and dielectrics:** Introduction, Capacitance of an isolated spherical conductor, Parallel plate, spherical and cylindrical condenser, Energy per unit volume in electrostatic field, Dielectric medium, Polarisation, Displacement vector, Gauss's theorem in dielectrics, Parallel plate capacitor completely filled with dielectric. **(10 Lectures, 20 Marks)**
2. **Magnetism:** Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility, Brief introduction of dia-, para- and ferro-magnetic materials. Introduction of Magnetostatics: Biot-Savart's law & its applications-straight conductor, circular coil, solenoid carrying current, Divergence and curl of magnetic field, Magnetic vector potential, Ampere's circuital law.

   (08 Lectures, 16 Marks)
3. **Electromagnetic Induction:** Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils, Energy stored in magnetic field. **(06 Lectures, 12 Marks)**
4. **Maxwell`s equations and Electromagnetic wave propagation:** Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization. **(06 Lectures, 12 Marks)**

Reference Books:

1. Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education.
2. Electricity and Magnetism, J.H. Fewkes& J. Yarwood. Vol. I, 1991, Oxford Univ.Press.
3. Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
4. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.11
5. Introduction to Electrodynamics, 3rd Edn,D.J. Griffiths, 1998, BenjaminCummings.
6. Electrodynamics- D. J. Griffiths

PHYSICS LAB- DSC 2A LAB: ELECTRICITY AND MAGNETISM (60 Lectures)

PHY 203: LAB-II

(Students should perform at least **ten** experiments from the following list)

1. To use a Multimeter for measuring (a) Resistances, (b) A.C. and D.C. Voltages, (c) D.C. Current, and (d) checking electrical fuses.
2. Ballistic Galvanometer:
   (i) Measurement of charge and current sensitivity
   (ii) Measurement of CDR
   (iii) Determine a high resistance by Leakage Method
   (iv) To determine Self Inductance of a Coil by Rayleigh's Method.
3. To compare capacitances using De'Sauty's bridge.
4. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx).
5. To study the Characteristics of a Series RC Circuit.
6. To study the a series LCR circuit and determine its (a) Resonant Frequency, (b)Quality Factor
7. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and(b) Quality factor Q
8. To determine a Low Resistance by Carey Foster's Bridge.
9. Verification of Kirchhoff's laws.
10. To verify Thevenin's theorem
11. To verify Norton's theorem
12. To verify Maximum Power Transfer Theorem
13. To verify Joule's law.
14. To determine time constant of R-C circuit using charging and discharging of condenser through resistor.
15. Determination of time constant of L-R circuit.
16. Electric billing with energy meter.
17. Frequency of a. c. using vibrating wire and magnet.
18. To determine efficiency and turns ratio of transformer.

Reference Books

1. Advanced Practical Physics for students, B.L.Flint&H.T.Worsnop, 1971, AsiaPublishing House.
2. A Text Book of Practical Physics, InduPrakash and Ramakrishna, 11th Edition,2011, KitabMahal, New Delhi.
3. Engineering Practical Physics, S.Panigrahiand B. Mallick, 2015, CengageLearningIndiaPvt. Ltd.
4. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4thEdition, reprinted 1985, Heinemann Educational Publishers.
5. Practical Course in Electronics by Prof. J. R. Patil and other (JaydeepPrakashan).

Equivalence Courses

Semester	Core Course		No of Credits	Hours/ Semester	Marks		Old Syllabus Code
	Course Code	Course Title			Int.	Ext.	
I	PHY-101	Basic Mechanics	2	30	40	60	PHY-122
	PHY-102	Dynamics and Elasticity	2	30	40	60	PHY-111
	PHY-103	LAB -I	2	60	40	60	PHY-113
II	Course Code	Course Title	No of Credits	Hours/ Semester	Marks		Old Syllabus Code
					Int.	Int.	
	PHY-201	Electricity and Electrostatics	2	30	40	60	PHY-112
	PHY-202	Magnetism and Electromagnetism	2	30	40	60	PHY-121
	PHY-203	LAB -II	2	60	40	60	PHY-123

FACULTY OF SCIENCE & TECHNOLOGY

KAVAYITRI BAHINABAI CHAUDHARI NORTH MAHARASHTRA UNIVERSITY, JALGAON

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

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

(AS PER CHOICE BASED CREDIT SYSTEM PATTERN OF UGC)

(With effect from June - 2019)

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 S.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 2019-20.

The main objective of the re-structuring the syllabus of S.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: **S. Y. B. Sc.** Subject: **Physics**

Choice Base Credit System (With effect from June 2019)

The Board of Studies in Physics in its meeting held on **4th July 2018** has unanimously accepted the revised syllabus (as per CBCS pattern) prepared by different committees, discussed and finalized in workshop restructuring of S.Y.B.Sc. Syllabus.

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

Semester	Course		No. of Credits	Hours per semester	Marks	
	Course code	Course Title			Internal marks	External marks
III	PHY 301	Thermodynamics and Kinetic theory of gases	02	30	40	60
	PHY 302(A) OR PHY 302(B)	Electronics-I OR Instrumentation	02	30	40	60
	PHY 303	LAB-III	02	60	40	60
	PHY 304: (Skill Enhancement course I)	Renewable energy and Energy Harvesting	02	30	40	60
IV	PHY 401	Waves, Oscillations and acoustics	02	30	40	60
	PHY 402	Optics and LASERS	02	30	40	60
	PHY 403	Lab IV	02	60	40	60
	PHY 404: (Skill Enhancement course II)	Electrical Circuits and Network Skills	02	30	40	60

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

Semester III: Physics paper I

PHY 301: Thermodynamics and Kinetic theory of gases

(Credits: 02) :(30 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Thermodynamics and kinetic theory of gases to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Thermodynamics and kinetic theory of gases.
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 Thermodynamics and kinetic theory of gases to real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Basics of thermodynamics and its First Law: (08 L, 15 M)

Thermodynamic Description of system, Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamical Processes, Applications of First Law: General Relation between C_P and C_V, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Coefficient, Reversible and irreversible processes.

Unit 2: Second and Third Law of Thermodynamics and Entropy: **(08 L, 15 M)**

Second law & Entropy, Carnot's cycle & theorem, Entropy changes in reversible and irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero, Enthalphy.

Unit 3: Heat Engines: (07 L, 15 M)

Carnot's Engine, Otto Engine and Cycle, Diesel Engine and Cycle, Efficiencies of all heat engines.

Unit 4: Kinetic Theory of Gases: (07 L, 15 M)

Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases.

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Reference Books:

- Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
- A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1969, Indian Press.
- Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications.
- Heat and Thermodynamics, M. W. Zemasky and R. Dittman, 1981, McGraw Hill 13
- Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W. Sears & G. L. Salinger. 1988, Narosa
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
- Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. Chand Publications

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Semester III: Physics paper II
PHY 302 (A): Electronics –I
(Credits: 02) :(30 Lectures 60 Marks)

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Course description:

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

Course objectives:

1. To impart knowledge of basic concepts in 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 Electronics to real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1 Semiconductor diodes **(07 L, 14 M)**

(Revision on metal, insulator and semiconductors, Intrinsic and Extrinsic semiconductor), Semiconductor Diodes: p and n type semiconductors. Barrier Formation in PN Junction Diode. Qualitative Idea of Current Flow Mechanism in Forward and Reverse Biased Diode. PN junction and its characteristics. Static and Dynamic Resistance. Principle, Construction, Working and Characteristics of (1) LEDs (2) Photodiode (3) Solar Cell (P-N Junction), (4) Zener Diode

Unit 2: **Rectifiers and Power Supplies** **(05 L, 10M)**

Introduction to Rectifiers, Types: Half-wave & Full-Wave Rectifiers (Centre-tapped and Bridge Rectifiers), Calculation of Ripple Factor and Rectification Efficiency, Basic idea about capacitor filter, D.C. power Supply (unregulated and regulated), Zener Diode as a voltage regulator.

Unit 3: Bipolar junction transistor **(06L, 12M)**

Bipolar Junction transistors: n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC configurations. Active, Cutoff, and Saturation Regions. Current gains α and β. Relations between α and β. Load Line analysis of Transistors. DC Load line and Q point.

Unit 4: Digital Electronics **(12 L, 24 M)**

Binary Numbers, Decimal to Binary and Binary to Decimal Conversion, Binary Addition, Binary Subtraction using 2's Complement Method, AND, OR and NOT Gates (Realization using Diodes and Transistor), NAND and NOR Gates as Universal Gates, XOR and XNOR Gates,

De Morgan's Theorems, Boolean Laws, Simplification of Logic Circuit using Boolean Algebra, Fundamental Products, Min terms and Max terms, Conversion of a Truth Table into an Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh's Map,

Half Adders and Full Adders and Subtractors, 4-bit binary Adder-Subtractor.

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Reference Books:

1. Electronic Principles – A. P. Malvino, Mc Graw-Hill Publishing House
2. Electronic fundamentals and applications – J. D. Ryder, Prentice Hall 4th Edition
3. Principles of Electronics – V. K. Mehta, S. Chand Publications, New Delhi
4. Electronic Devices and Circuits – Allen Mottershead, Good year Publishing Company
5. Digital Principles and Applications – Malvino and Leach, Mc Graw-Hill Publication.
6. Modern Digital Electronics – R. P. Jain, Tata Mc Graw-Hill Pvt. Ltd., New Delhi
7. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
8. Electronic devices and circuits, S. Salivahanan and N. Suresh Kumar, 2012, Tata Mc-Graw Hill.
9. Microelectronic Circuits, M.H. Rashid, 2ndEdn.,2011, Cengage Learning.
10. Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., Oxford University Press.
11. Fundamentals of Digital Circuits, A. Anand Kumar, 2nd Edition, 2009, PHI Learning Pvt. Ltd.

Semester III: Physics paper II

PHY 302 (B): Instrumentation

(Credits: 02) :(30 Lectures 60 Marks)

[Note: For students opting electronics as one of the subjects at F. Y. B. Sc. Class]

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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 of use of knowledge of Instrumentation to real life problems.
2. Understanding of the course will create scientific temperament.

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Unit-I Fundamentals of Measurements: (04L, 8M)

Functional elements of typical measurement system, Standards of measurements and calibration, Static performance characteristics: Accuracy, Precision, Accuracy versus precision, Sensitivity, Linearity, Concept of Errors and their types.

Unit-II Measurement of Temperature: (10L, 20M)

Non - electrical Methods : Liquid- in-glass Thermometer, Pressure Thermometer construction and their types: constant volume gas thermometer and Vapour pressure Thermometer, **Electrical Methods :** Thermo-electric Sensors (Thermocouple), Metallic resistance Thermometer (Platinum resistance thermometer), Semiconductor resistance sensors (Thermistor).

Radiation Methods (Pyrometry) : Total Radiation Pyrometer, Selective Radiation Pyrometer.

Unit-III: **Measurement of Pressure: (08L, 16M)**

High pressure Measurement, Measurement of low pressure (Vacuum): McLaud Guage, Pirani Gauge, Calibration & Testing (Dead - weight tester)

Unit-IV: Acoustics (Sound) Measurement: (08L, 16M)

Characteristics of sound, Sound pressure level, Sound power level, Variation of intensity of sound with distance, Typical sound measuring system (Sound level Meter), Microphones : Condenser or capacitor type Microphone, Electrets Microphone, Electrodynamics types of Microphone, Carbon granules type Microphone

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Reference Books :

1. Instrumentation, Measurement & Analysis by (Nakra and Chaudhary), 2nd Edition
2. Instrumentation : Devices & Systems by (Rangan, Mani & Sarma), 2nd Edition
3. Basic Electronics by B. L. Thereja.
4. A Course In Electrical & Electronics Measurement & Instrumentation by A. K. Sawhney
5. Modern electronic instrumentation and Measurement Techniques by Helfrick & Cooper.

Semester III: Physics paper III:

PHY 303: Lab III

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

(Note: Total 10 experiments should be performed. Minimum 05 experiments from both sections should be performed.)

Section A: General Physics-I

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. To determine the mechanical equivalent of heat (J) with the help of Joules calorimeter.
3. To determine the coefficient of thermal conductivity of a bad conductor by Lee's method and Charlton's disc method.
4. To determine the coefficient of thermal conductivity of copper by Searle's Apparatus.
5. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
6. To determine thermal conductivity of rubber by tubing method.
7. To determine thermal conductivity of metal by Forbe's method.
8. To Verify Clausius-Clapeyron equation.
9. Jolly's steam calorimeter.
10. To determine the temperature co-efficient of resistance by Platinum resistance thermometer.
11. To study the variation of thermo e. m. f. across two junctions of a thermocouple with temperature.
12. Stefan's fourth power law using bulb.
13. To determine angle of prism and familiarization with Schuster`s focusing.
14. To determine the Refractive Index of the Material of a given Prism using Sodium Light.
15. To determine Dispersive Power of the Material of a given Prism using Mercury Light.
16. To determine Stefan's constant.

Section B: Electronics

1. Study of full wave rectifier with capacitor filter and to calculate its ripple factor.
2. Study of zener diode as a voltage regulator.
3. Study of CE transistor characteristics to find out 'β' of the transistor.
4. Study of logic gates (AND, OR and NOT) using diodes and transistors.
5. Verification of De Morgan's Theorems (using ICs).
6. To study the characteristics of Light Emitting Diode (LED).
7. Experimental verification of NAND gate as a universal building block.
8. Experimental verification of NOR gate as a universal building block.
9. To study I – V characteristic of (i) a resistor and (ii) a p–n junction diode and compare it.
10. Frequency response of CE single stage transistor amplifier and to calculate its bandwidth.
11. To determine fill factor and efficiency of solar cell.
12. Comparison of luminous intensities of two light sources by using photo voltaic cell.

OR Section B: Instrumentation

1. 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).
2. To obtain Lissajous figures using C.R.O.
3. To determine characteristics of Thermistor and to find an unknown temperature by using thermistor.
4. Use of thermocouple for measurement of temperature.
5. Measurement of errors.
6. Directional characteristics of a microphone.

7. Platinum resistance thermometer. (Determine the melting temperature of Wax)
8. Velocity of sound by phase shift method.
9. Measurement of Noise by Using Sound Pressure level Meter.

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Reference Books:

1. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
4. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, 1985, Vani Publication.
5. A text Book of Experimental Physics – Dr. V.Y. Rajopadhye, V.L.Purohit and A. S. Deshpande (Continental Prakashan, Poona-30).
6. AN ADVANCED COURSE IN PRACTCIAL PHYSICS- D. Chattopadhyay and P.C. Rakshit.
7. Practical Physics by R. K. Shukla, Anchal Srivastava (New Age International).
8. B.Sc. Practical Physics by Harnam Singh and Dr. P.S. Hemne (S. Chand).
9. Advance Practical Physics by S.P.Singh (Pragati).
10. College Practical Physics: Khanna and Gulati (S. Chand and Co. Ltd , Delhi)
11. Practical Physics: Gupta and Kumar (Pragati Prakashan Meerat)
12. Advanced Level Practical Physics: J. M.Nelkon, J.M.Ogloom (EIBS)
13. A Text book of practical Physics: Shrinivasan and Balasubranian
14. A Text book of practical Physics: Indu Prakash and Ramkrishna.
15. B.Sc. Practical Physics by C.L. Arora (S. Chand and Co. Ltd , Delhi)
16. Practical Course in Electronics by Prof. J.R.Patil and other (Jaydeep Prakashan).

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Semester III: Physics paper IV

PHY 304: Skill Enhancement Course I (SEC-I)

Renewable energy and Energy Harvesting (Credits: 02) Theory: (30 L, 60M)

[The aim of this course is not just to impart theoretical knowledge to the students but to provide them with exposure and hands-on learning wherever possible]

Unit 1.Conventional and Non-conventional energy Sources: Fossil fuels and Nuclear Energy, their limitation, need of renewable energy, non-conventional energy sources. (**02L, 04M**)

Unit 2 . Solar Energy

Solar energy, its importance, storage of solar energy, solar pond, non convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems. Solar energy utilization by Solar roof panels. **(06 L,12 M)**

Unit 3. Ocean, geothermal, Hydro and Biomass energy resources.

a. **Ocean Energy**: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. **(03 L,06M)**
   Tidal energy,Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power. **(02 L,04M)**
b. **Geothermal Energy**: Geothermal Resources, Geothermal Technologies. **(02 L,04M)**
c. **Hydro Energy**: Hydropower resources, hydropower technologies, environmental impact of hydro power sources. **(02 L, 04M)**
d. **Biomass energy:** biomass, biochemical conversion, biogas generation, Ocean biomass **(02L,04M)**

Unit 4. Energy Harvesting:

a. **Wind Energy harvesting**: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies **(03 L,06M)**
b. **Piezoelectric Energy harvesting**: Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energy harvesting applications, Human power **(04 L,08M)**
c. **Electromagnetic Energy Harvesting**: Linear generators, physics mathematical models, recent applications, **(02 L,04M)**
d. Carbon captured technologies, cell, batteries, power consumption **(01 L,02M)**
e. Environmental issues and sustainability of renewable energy sources,. **(01 L,02M)**

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Demonstrations and Experiments

1. Demonstration of Training modules on Solar energy, wind energy, etc.
2. Conversion of mechanical energy (vibration) into voltage using piezoelectric materials
3. Conversion of thermal energy into voltage using thermoelectric modules.

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Reference Books:

1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
2. Solar energy - M P Agarwal - S Chand and Co. Ltd.
3. Solar energy - Suhas P Sukhatme Tata McGraw - Hill Publishing Company Ltd.
4. Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004, Oxford University Press, in association with The Open University.
5. Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009
6. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).
7. http://en.wikipedia.org/wiki/Renewable_energy

Semester IV: Physics paper V

PHY 401: Waves, Oscillations and Acoustics

(Credits: 02) : (30 Lectures 60 Marks)

Course description:

This course is aimed at introducing the fundamentals of Waves and Sound to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Waves and Sound.
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 Waves and Sound to real life problems.
2. Understanding of the course will create scientific temperament.

Unit I: Composition of two S. H. M.'s

Composition of two S.H.M.s of equal frequencies along same line (co-linear) of vibration (analytical method only), Composition of two S.H.M.s of equal frequencies acting at right angles (analytical method with different cases), Composition of two S.H.M.'s right angles to each other (time period in the ratio 1:2), Lissajous figures- demonstration by mechanical, optical and electrical methods, applications of Lissajous figure (list only). **(06L, 16M)**

Unit II: Waves Motion

General: Transverse waves on a string. Travelling and standing waves on a string. Normal Modes of a string. Plane waves, Spherical waves, Wave intensity. **(05L, 8 M)**

Unit - III: Forced oscillations

Idea of forced oscillations, Resonance and its types- Mechanical resonance (Barton's pendulum), Acoustic resonance (resonance tube), Electrical resonance (LCR circuit) and Optical resonance (sodium vapour lamp), Differential equation of forced oscillations and its solution, Amplitude of forced oscillations, Amplitude resonance, Application to series L-C-R circuit. **(08L, 16M)**

Unit IV: Sound:

Parameters of Sound: Sound intensity, Loudness, Pitch, Quality and timber, Acoustic intensity level measurement, Acoustic pressure and its measurement. Reverberation and time of reverberation.

Ultrasonics: Classification of sound frequencies, Piezoelectric effect, Generation of ultrasonic waves by Piezoelectric oscillator (using transistor), Application of ultrasonic waves (list only).

Doppler effect: Doppler effect in sound, Expression for apparent frequency (no derivation), discussion of different cases when source, observer and medium are in relative motion, Asymmetric nature of Doppler effect in sound, Doppler effect in light, Symmetric nature of Doppler effect in light, Applications of Doppler effect in sound and light. **(11L, 20M)**

Reference Books:

1. Waves and oscillations- Brijlal and Subramaniyam (Vikas Publishing House)
2. Waves and Oscillations- R.N. Chaudhari, New Age International (Pvt.) Ltd.
3. Conceptual Physics- A. P. Taggarase, Jivan Sheshan (Himalaya Publishing).
4. The Physics of Waves and Oscillations- N. K. Bajaj (Tata McGraw Hill).
5. Oscillations and Waves- B. S. Agarwal (KedarNath, Ram Nath Publishers)
6. Sound- Mee and Heinmann, London Edition

Semester IV: Physics paper VI

PHY 402: Optics and LASERS

(Credits: 02) : (30 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Optics and LASERS to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Optics and LASERS.
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 Optics and LASERS to real life problems.
2. Understanding of the course will create scientific temperament.

……..…….

Unit I: Geometrical Optics: Deviation produced by thin lenses, equivalent focal length of two thin lenses separated by a distance and when in contact. Power of lens, Spherical aberration in lens, reduction of spherical aberration (without derivation), Chromatic aberration, Achromatism; (two lenses in contact and separated by finite distance without derivation). **(04L, 10M)**

Unit II: Interference: Principle of superposition of two, Concept of interference, Intensity distribution in the interference pattern, Division of amplitude and division of wavefront. Young's Double Slit experiment, Expression for fringe width, Fresnel's Biprism and Lloyd's Mirror. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). fringe width in case of fringes of equal thickness. Newton's rings-experimental setup, theory and its application to determine wavelength of source and refractive index of liquids **(10L, 20M)**

Unit III : Diffraction: Definition of diffraction, Concept of diffraction, Types of diffraction, Fresnel Diffraction: Half-period zones, Zone plate, Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis, Fraunhofer diffraction: Single slit; Double Slit. Multiple slits and Diffraction grating. **(08L, 14M)**

Unit IV: Polarization: Polarization, Polarization by reflection, Brewster's law, Polarization by double refraction in uniaxial crystals, Maluss Law Double refracting crystals, Positive and negative crystals, Production and detection of circularly and elliptically polarized light, Nicol prism, Optical activity, Rotation of the plane of polarization, Specific rotation, Polarimeter or Sacherimeter, (Principle and working). **(04L, 10M)**

Unit V: Non-linear optics: Principle of LASER, Characteristics of LASER, Basic steps required to form a LASER: absorption, spontaneous emission, stimulated emission, Metastable state, population inversion, optical pumping, Types of LASER- He-Ne LASER, Applications of LASER (list only) **(04L, 06M)**

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Reference Books:

1. Fundamentals of Optics, F A Jenkins and H E White, 1976, McGraw-Hill
2. Principles of Optics, B.K. Mathur, 1995, Gopal Printing
3. Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, R. Chand Publication
4. University Physics. FW Sears, MW Zemansky and HD Young 13/e, 1986.Addison-Wesley
5. Lasers and nonlinear optics – B. B. Laud
6. An Introduction to Laser – Theory and applications – M. N. Avadhanale
7. A textbook of Optics: Dr. N. Subrahmanyam, Brijlal and Dr. M.N.Avadhanulu, S.Chand Publishing,Co.Ltd.
8. Optics: Singh and Agrwal, Pragati Prakashan, Meerut.
9. Optics and Thermodynamics- Sarkar and Sharma, Himalaya Publishing House

Semester IV: Physics paper VII:

PHY 403: Lab IV - General Physics II

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

(Note: Total 10 experiments should be performed.)

1. To investigate the motion of coupled oscillators.
2. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify λ^2 – T Law.
3. To study Lissajous Figures and demonstration of Lissajous figures by using C.R.O.
4. Study of acoustic resonance by using bottle as a resonator.
5. Determination of velocity of sound by using Kundt's tube.
6. Study of resonance using Kater's pendulum.
7. Log decrement
8. Damping coefficient
9. Study of acoustic resonance by using resonance tube.
10. To determine the Resolving Power of a Prism.
11. To determine the value of Cauchy Constants of a material of a prism.
12. To determine wavelength of sodium light using Fresnel Biprism.
13. To determine wavelength of sodium light using Newton's Rings.
14. To determine the refractive index of a liquid by using Newton's rings apparatus.
15. Determination of specific rotation α of optically active substance using Polarimeter.
16. Measurement of beam size of a LASER beam.
17. Measurement of beam divergence of a LASER beam.
18. To determine the wavelength of light from LASER source using Diffraction grating.
19. To determine wavelength of (1) Sodium & (2) spectrum of Mercury light using plane diffraction Grating
20. To determine the Resolving Power of a Plane Diffraction Grating.
21. To measure the intensity using photosensor and laser in diffraction patterns of single and double slits.

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Reference Books:

1. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
4. B.Sc. Practical Physics: C. L. Arora, S. Chand Publishing Co. Ltd., New Delhi

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Semester IV: Physics paper VIII

PHY 404: Skill Enhancement Course II

Electrical Circuits and Network Skills

(Credits: 02) : (30 Lectures 60 Marks)

[The aim of this course is to enable the students to design and trouble shoots the electrical circuits, networks and appliances through hands-on mode]

Unit 1. Basic Electricity Principles: Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations. AC Electricity and DC Electricity. Familiarization with multimeter, voltmeter and ammeter. **(03 L, 06 M)**

Unit 2. Understanding Electrical Circuits: Main electric circuit elements (R,L,C) and their combination. Rules to analyze DC sourced electrical circuits (KCL, KVL) Current and voltage drop across the DC circuit elements, Diode and rectifiers, . Response of inductors and capacitors with DC or AC sources Single-phase and three-phase alternating current sources. Rules to analyze AC sourced electrical circuits. Real, imaginary and complex power components AC source. Power factor. Saving energy and money. **(07 L, 14 M)**

Unit 3. Electrical Drawing and Symbols: Drawing symbols. Blueprints. Reading Schematics. Ladder diagrams. Electrical Schematics. Power circuits. Control circuits. Reading of circuit schematics. Tracking the connections of elements and identify current flow and voltage drop. **(04L, 08M)**

Unit 4.Generators and Transformers: Types of DC Power sources. Principle of DC/AC generators, construction of DC generator, Operation of transformers. **(03 L, 06 M)**

Unit 5.Electric Motors: Single-phase AC & DC motors (Basic design). Interfacing DC or AC sources to control heaters & motors. Speed & power of ac motor. **(04 L, 8 M)**

Unit 6.Electrical Protection: Relays. Fuses and disconnect switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Interfacing DC or AC sources to control elements (relay protection device) **(04L, 08 M)**

Unit 7.Electrical Wiring: Different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits. Insulation. Solid and stranded cable. Conduit. Cable trays. Splices: wirenuts, crimps, terminal blocks, split bolts, and solder. Preparation of extension board. **(05 L, 10 M)**

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Reference Books:

1. A text book in Electrical Technology - B L Theraja - S Chand & Co.
2. A text book of Electrical Technology - A K Theraja
3. Performance and design of AC machines - M G Say ELBS Edn.
4. Electrical Technology by V.K.Meheta

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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.

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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.