2011 - 12
Semester Scheme

BANGALORE UNIVERSITY

Scheme of Instruction & Examination for B.Sc. (Physics)

SEMESTER SCHEME

(from 2011 - 12)

ಬೆಂಗಳೂರು ವಿಶ್ವವಿದ್ಯಾಲಯ

ಜ್ಞಾನಭಾರತಿ, ಬೆಂಗಳೂರು – 560 056.

ಸಂಖ್ಯೆ :ಎಸಿಎ–2/ಎ3/ಸೆ.ಪ/ಯು.ಜಿ–ಪಿ.ಜಿ/ಪರಿಷ್ಕೃತ/ಹೊಸ. ಪ.ಕ್ರ/2010–11, ದಿನಾಂಕ : 09.08.2010

ಅಧಿಸೂಚನೆ

ವಿಷಯ: ಬೆಂಗಳೂರು ವಿಶ್ವವಿದ್ಯಾಲಯದ ವಿಜ್ಞಾನ ನಿಖಾಯಕ್ಕೆ ಸಂಬಂಧಪಟ್ಟ ಸ್ನಾತಕ ಮತ್ತು ಸ್ನಾತಕೋತ್ತರ ಪದವಿ ಕೋರ್ಸುಗಳ ಸೆಮೆಸ್ಟರ್/ವಾರ್ಷಿಕ ಪದ್ಧತಿಯ ಪರಿಷ್ಕೃತ / ಹೊಸ ಪಠ್ಯಕ್ರಮಗಳನ್ನು ಜಾರಿಗೊಳಿಸುವ ಬಗ್ಗೆ.

ಉಲ್ಲೇಖ: 1. ದಿನಾಂಕ 06.01.2010 ಮತ್ತು 01.06.2010ರ ವಿಜ್ಞಾನ ನಿಖಾಯದ ಸಭೆಗಳ ನಿರ್ಣಯ.
2. ದಿನಾಂಕ 27.03.2010 ರಂದು ನಡೆದ ವಿದ್ಯಾವಿಷಯಕ ಪರಿಷತ್ತಿನ ಸಾಮಾನ್ಯ ಸಭೆ ಹಾಗೂ ದಿನಾಂಕ 26.07.2010ರ ಮುಂದೂಡಿದ ವಿದ್ಯಾವಿಷಯಕ ಪರಿಷತ್ತಿನ ನಿರ್ಣಯ

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ದಿನಾಂಕ 27.03.2010 ರಂದು ನಡೆದ ವಿದ್ಯಾವಿಷಯಕ ಪರಿಷತ್ತಿನ ಸಾಮಾನ್ಯ ಸಭೆ ಹಾಗೂ ದಿನಾಂಕ 26.07.2010ರ ಮುಂದೂಡಿದ ವಿದ್ಯಾವಿಷಯಕ ಪರಿಷತ್ತಿನ ಸಾಮಾನ್ಯ ಸಭೆಗಳಲ್ಲಿ ಕೈಗೊಂಡ ನಿರ್ಣಯದನ್ವಯ ವಿಜ್ಞಾನ ನಿಖಾಯಕ್ಕೆ ಸಂಬಂಧಿಸಿದಂತೆ, ಈ ಕೆಳಕಂಡ ಸ್ನಾತಕ / ಸ್ನಾತಕೋತ್ತರ ಪದವಿ ಕೋರ್ಸುಗಳಲ್ಲಿ ಸೆಮೆಸ್ಟರ್ / ವಾರ್ಷಿಕ ಪದ್ಧತಿಯ ಪರಿಷ್ಕೃತ / ಹೊಸ ಪಠ್ಯಕ್ರಮಗಳನ್ನು ಆವುಗಳ ಮುಂದೆ ನಮೂದಿಸಿರುವಂತೆ ಬೆಂಗಳೂರು ವಿಶ್ವವಿದ್ಯಾಲಯವು ಅಧಿಕೃತವಾಗಿ ಈ ಮೂಲಕ ಪ್ರಕಟಿಸಿದೆ.

ಕ್ರ.ಸಂ	ಕೋರ್ಸುಗಳ ವಿವರ	ಅನುಮೋದಿಸಿದ ಸೆಮೆಸ್ಟರ್‌ಗಳು	ಅನುಮೋದಿಸಿದ ಹೊಸ/ಪರಿಷ್ಕೃತ ಅಸ್ತಿತ್ವದಲ್ಲಿರುವ ಪಠ್ಯಕ್ರಮಗಳು	ಜಾರಿಗೊಳಿಸಲಾದ ಶೈಕ್ಷಣಿಕ ವರ್ಷ
1.	Four Years B.S., Course	I to IV Semester	New Course	2010–11
2.	B.Sc Physics	I to IV Semester	Revised	2011–12
3	M.Sc Physics	I to IV Semester	Revised	
5	B.Sc Mathematics	I to VI Semester	Revised	
6	M.Sc Mathematics	I to IV Semester	Revised	
7	M.Sc Mathematics	Annual System (Ist & IInd Year)	Revised	
7	B.Sc Botany	I to VI Semester	Revised	
8	M.Sc Botany	I to IV Semester	Revised	
9	B.Sc Electronics	I to IV Semester	Revised	2009–10
10	M.Sc Electronic Science	Revised Syllabus for one practical paper of M.Sc II Sem (EL-206P)	Revised Syllabus for one practical paper of M.Sc II Sem (EL-206P)	
11	Bachelor of Computer Application	III to VI Semester	Revised	

ಆದೇಶದ ಮೇರೆಗೆ

ಕುಲಸಚಿವರು

ಗೆ.

ವಿಶ್ವವಿದ್ಯಾಲಯಕ್ಕೆ ಸಂಯೋಜಿತಗೊಂಡಿರುವ ವಿಜ್ಞಾನ ವಿಷಯವನ್ನು ಬೋದಿಸುತ್ತಿರುವ ಎಲ್ಲಾ ಕಾಲೇಜುಗಳ ಪ್ರಾಂಶುಪಾಲರುಗಳು ಮೇಲ್ಕಂಡ ಕ್ರಮಸಂಖ್ಯೆ 2 ರಿಂದ 11 ರವರೆಗೆ ಕೋರ್ಸುಗಳ ಪಠ್ಯಕ್ರಮಗಳನ್ನು ವಿದ್ಯಾಕಾರ್ಯಶಾಖೆ–2 ರಿಂದ ಒಂದು ಪತ್ರದ ಮುಖೇನ ಪಡೆಯಬಹುದಾಗಿದೆ.

ಪು.ತಿ.ನೋ.

ಪ್ರತಿಗಳು:

1. ಡೀನರು, ವಿಜ್ಞಾನ ನಿಕಾಯ, ಬೆಂಗಳೂರು ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಂಗಳೂರು.
2. ವಿಜ್ಞಾನ ನಿಕಾಯಕ್ಕೆ ಸಂಬಂಧಿಸಿದ ಮೇಲ್ಕಂಡ ಕ್ರಮಸಂಖ್ಯೆ 2 ರಿಂದ 11 ರವರೆಗಿನ ಕೋರ್ಸುಗಳ ವಿಭಾಗಗಳ ಮುಖ್ಯಸ್ಥರುಗಳು, ಬೆಂಗಳೂರು ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಂಗಳೂರು – ಸಂಬಂಧಪಟ್ಟ ಪರಿಷ್ಕೃತ ಪಠ್ಯಕ್ರಮಗಳನ್ನು ವಿಶ್ವವಿದ್ಯಾಲಯದ ಗ್ರಂಥಾಲಯ ವೈಬ್‌ಸೈಟ್‌ನಲ್ಲಿ ಪ್ರಕಟಿಸಲು Soft copy and Hard copy ಗಳನ್ನು ಗ್ರಂಥಪಾಲಕರಿಗೆ ಒದಗಿಸಲು ಕೋರಲಾಗಿದೆ.
3. ಕುಲಸಚಿವರು (ಮೌಲ್ಯಮಾಪನ), ಬೆಂಗಳೂರು ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಂಗಳೂರು.
4. ಸಹಾಯಕ ಕುಲಸಚಿವರು, ವಿದ್ಯಾಶಾಖೆ–1, 3 ಮತ್ತು 4, ಬೆಂಗಳೂರು ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಂಗಳೂರು.
5. ಉಪಕುಲಸಚಿವರು ವಿದ್ಯಾಶಾಖೆ–2, ಬೆಂಗಳೂರು ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಂಗಳೂರು.
6. ನಿರ್ದೇಶಕರು, ಆಂತೆ ತರಬಿನ ಮತ್ತು ದೂರಶಿಕ್ಷಣ ನಿರ್ದೇಶನಾಲಯ, ಬೆಂಗಳೂರು ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಂಗಳೂರು.
7. ನಿರ್ದೇಶಕರು, ಪ್ರಸಾರಾಂಗ, ಬೆಂಗಳೂರು ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಂಗಳೂರು ಮುಂಬರುವ ಗೆಜೆಟ್‌ನಲ್ಲಿ ಪ್ರಕಟಿಸಲು ಕೋರಿದೆ.
8. ಗ್ರಂಥಪಾಲಕರು, ಬೆಂಗಳೂರು ವಿಶ್ವವಿದ್ಯಾಲಯ ಗ್ರಂಥಾಲಯ – ಸಂಬಂಧಪಟ್ಟ ಪಠ್ಯಕ್ರಮಗಳನ್ನು ವಿಶ್ವವಿದ್ಯಾಲಯದ ವೆಬ್‌ಸೈಟ್‌ನಲ್ಲಿ ಪ್ರಕಟಿಸಲು ಕೋರಿದೆ.
9. ಕುಲಪತಿಗಳ/ಕುಲಸಚಿವರ ಆಪ್ತಕಾರ್ಯದರ್ಶಿಗಳಿಗೆ, ಬೆಂಗಳೂರು ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಂಗಳೂರು.
10. ಸಮನ್ವಯಾಧಿಕಾರಿಗಳು, ಸಂಖ್ಯಾಶಾಸ್ತ್ರ ವಿಭಾಗ, ಬೆಂಗಳೂರು ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಂಗಳೂರು.
11. ಕಛೇರಿ ಪ್ರತಿ.

BANGALORE UNIVERSITY

Scheme of Instruction & Examination for B.Sc.

Semester Scheme (from 2010- 11)

Serial Number	Course number	Teaching hours per week	Examination duration	Maximum marks		Maximum total marks
				Final exam	Internal Assessment	
01	PHY 101	4	3 hours	60	10	100
02	PHY 102	3	3 hours	30		
03	PHY 201	4	3 hours	60	10	100
04	PHY 202	3	3 hours	30		
05	PHY 301	4	3 hours	60	10	100
06	PHY 302	3	3 hours	30		
07	PHY 401	4	3 hours	60	10	100
08	PHY 402	3	3 hours	30		
09	PHY 501	3	3 hours	60	10	100
10	PHY 502	4	4 hours	30		
11	PHY 503-A	3 hours for each elective paper	3 hours	60	10	100
12	PHY 503-B					
13	PHY 503-C					
14	PHY 503-D					
15	PHY 503-E					
16	PHY 504-A	4 hours for each elective lab	4 hours	30		
17	PHY 504-B					
18	PHY 504-C					
19	PHY 504-D					
20	PHY 504-E					
21	PHY 601	3	3 hours	60	10	100
22	PHY 602	4	4 hours	30		
23	PHY 603-A	3 hours for each elective paper	3 hours	60	10	100
24	PHY 603-B					
25	PHY 603-C					
26	PHY 603-D					
27	PHY 603-E					
28	PHY 604-A	4 hours for each elective lab	4 hours	30		
29	PHY 604-B					
30	PHY 604-C					
31	PHY 604-D					
32	PHY 604-E					
					Grand total	**800**

Note-I:

- The course number is a three digit number with ' **0** ' in the middle
- The digit to the left of ' **0** ' indicates the semester number
- Odd number to the right of '**0**' indicates a theory paper
- Even number to the right of '**0**' indicates a practical paper
- PHY 501 and PHY 502 are the common papers of the fifth semester
- PHY 601 and PHY 602 are the common papers of the sixth semester
- The course numbers with the alphabets A, B, C, D and E indicate the optional / elective papers in both theory and practical in the fifth and sixth semesters

Note-II:

The marks distribution for the final practical examination is as follows:

- Formula/Formulae with explanation of symbols - 03 marks
- Diagram/Circuit diagram and tabular column - 03 marks
- Experimental setup + systematic entry of readings - 08 marks
- Accuracy of readings - 05 marks
- Graph and Calculations - 03 marks
- Final result and units - 03 marks
- Practical record book valued by the examiner - 05 marks

Total for the practical examination – 30 marks

Note-III:

A minimum of **EIGHT** (8) experiments must be performed in each practical paper

Syllabus for I Sem B.Sc. (Physics)
Phy-101: Mechanics, Oscillations and Properties of matter

Unit -1

Motion & Friction

Newton's laws of motion with illustrations (review); Enumeration of II law - Motion in a resistive medium; Examples of drag force, concept of terminal velocity; role of static and dynamic friction; Motion along inclined plane with and without frictional force; Use of free body diagrams 6 hours

Frames of reference

Inertial and Non inertial frames of reference; Galilean relativity; Postulates of special theory of relativity; Lorentz transformation equation (no derivation); mass energy equivalence; length contraction and time dilation 7 hours

Unit -2

Planetary & Satellite motion

Motion along a curve - radial and transverse components of acceleration; Newton's law of gravitation, Kepler's laws (statements only); Escape velocity and orbital velocity; Launching of artificial Satellite; Geostationary and geosynchronous satellites. 5 hours

Work & Energy

Work done by a constant and variable force; Work energy theorem; Work and potential energy; examples of potential energy; Work done by gravitational force; Work done by a spring force; Conservative and non conservative force; Conservation of energy 4 hours

Surface tension

Molecular interpretation of surface tension; Surface energy; Angle of contact and wetting; Pressure difference across a curved surface; Interfacial tension; Drop weight method with necessary theory; Factors affecting surface tension 4 hours

Unit - 3

System of particles

Centre of mass of rigid bodies; Newton's law for a system of particles; Linear momentum for a particle and a system of particles; Conservation of linear momentum; System with varying mass; Rocket motion; Elastic and inelastic collisions (oblique) 5 hours

Moment of inertia

Review of rotational motion of Rigid bodies; Kinetic energy of rotation-Moment of Inertia of a body; Theorem of Moment of Inertia-Parallel and perpendicular axes theorem with proofs (2-D case); Calculation of moment of inertia of a disk, annular ring, solid sphere and rectangular bar; Conservation of angular momentum with illustrations 8 hours

Unit - 4

Oscillation

SHM; Simple and compound pendulum; damped oscillations; forced oscillations - concept of resonance; coupled oscillators 5 hours

Elasticity

Review of elastic properties; Relationship between three elastic constants; Poisson's ratio; Work done in stretching a wire; Bending of beams; Bending moment, Theory of single cantilever, Couple per unit twist, Torsional oscillations 8 hours

References:

1. Fundamentals of Physics- R Resnik and D Halliday, Wiley 2001
2. Physics-Classical and Modern, FJKeller, EGettys and JJSkove, McGraw Hill Second Edition
3. Classical Mechanics-KNSreenivasaRao, Universities Press - Orient Longman
4. Concepts of Physics Vol (1)-HC Verma, Bharathi Bhavan Publishers, 2004 Edition
5. University Physics- FWSears, MW Zemansky & HDYoung, Narosa Publications- Delhi
6. Mechanics- JCUpadhaya, Ramprasad & Co, Agra
7. Mechanics- Berkeley Physics Course Vol(1)- Mittal, Knight & Rudermann, TMH Delhi, 1981
8. Mechanics- EMPurcell, McGraw Hill
9. Oscillations and Waves – DPKhandelwal, Himalaya Publishing House
10. Elements of Properties of matter - DSMathur, Shamlal Charitable Trust, Delhi, 1996
11. Properties of Matter - Brijlal & Subramanyam, SChand & Co, 1982
12. Newtonian Mechanics- APFrench, Nelson & Sons UK, 1971
13. Mechanics & Thermodynamics, GBasavaraju & Dipan Ghosh, TMH Publishing Limited, New Delhi
14. A treatise on general properties of matter, Sengupta and Chatterjee, (Fifth edition -2001) New Central Book Agency, Calcutta
15. Waves & Oscillations, PKMittal & Jai Dev Anand, Hari Anand Publications (1994)

Phy-102: Practical Physics – I

List of Experiments

1. Atwood machine - with photogate
2. Torsional pendulum - to determine C and Rigidity modulus
3. Spring mass- (a) static case to determine 'k'
   (b) dynamic case to determine 'k'
   (c) 'k' as a function of L of spring
4. Bar pendulum - effective length and T
5. Rigid pendulum - T and decay of amplitude
6. Coupled oscillator - string coupled with change of tension
7. Simple pendulum - dependence of T on amplitude
8. Rolling dumb bell - on parallel inclined rails
9. Verification of parallel and perpendicular axis theorem
10. Searle's double bar
11. Work done by variable force
12. Cantilever of negligible mass to find Young's modulus
13. q- by Stretching
14. Fly wheel
15. Verification of principle of conservation of energy
16. Determination of coefficients of static, kinetic and rolling frictions
17. q by uniform bending
18. q by single cantilever

Note: A minimum of EIGHT (8) experiments must be performed

References:

1. B Saraf etc, - Physics through experiments, Vikas Publications
2. DP Khandelwal – A Laboratory Manual of Physics for Undergraduate Classes, Vani Publications
3. Advanced Practical Physics for Students – Worsnop & Flint, Methuen & Co, London
4. An Advanced Course in Practical Physics , D Chattopadhyay, PC Rakshit, B Saha, New Central Book Agency (P) Limited, Kolkata, Sixth Revised Edition, 2002
5. BSC, Practical Physics, CLArora, S Chand & Co, New Delhi, 2007 Revised Edition

Syllabus for II Sem B.Sc. (Physics)
Phy-201: Thermal physics and Statistical mechanics

Unit - 1

Kinetic Theory of Gases

Basic assumptions of kinetic theory; Derivation of $pV = \frac{1}{3}mnc^2$ - deduction of perfect gas equation; Maxwell's law of distribution of velocity *(without derivation)* ; Calculation of most probable velocity, mean velocity and root mean square velocity; Derivation of expression for mean free path; Degrees of freedom and principle of equipartition of energy; Derivation of $U = \frac{3}{2}RT$, Specific heats of an ideal gas, atomicity of gases 7 hours

Transport Phenomena

Viscosity and thermal conduction in gases *(with derivation)* ; Relation between coefficient of viscosity and coefficient of thermal conductivity of a gas 2 hours

Real Gases

Derivation of van der Waal's equation of state; Andrews experiments on Carbon dioxide; Derivation of the critical constants; Comparison of van der Waal's isotherms with Andrew's isotherms 4 hours

Unit – 2: Thermodynamics

Basic Concepts and the Zeroth law of thermodynamics

Macroscopic and microscopic descriptions of a system; Thermal Equilibrium - Zeroth Law of Thermodynamics; Concept of temperature; Thermodynamic equilibrium; Thermodynamic coordinates - extensive and intensive; Equations of state; Various processes - PVT indicator diagrams 3 hours

First Law of Thermodynamics

The first law of Thermodynamics; Sign convention for heat and work; Work done in an isothermal process for an ideal gas; Internal energy as a state function; Application of the first law for (i) Cyclic Process (ii) Adiabatic Process (iii) Isochoric Process (iv) Isobaric Process and (v) Isothermal Process 3 hours

Second Law of Thermodynamics

Reversible and irreversible processes; Carnot Cycle and its efficiency (with derivation); Second law of thermodynamics (Kelvin's & Clausius' statements and their equivalence); Carnot Engine; Practical internal combustion engines - Otto and Diesel Cycles (qualitative treatment); Carnot theorem; The thermodynamic temperature scale; Refrigerator- Coefficient of performance 3 hours

Entropy

The concept of entropy; Entropy of an ideal gas; Entropy - reversible process, Entropy - irreversible process; Entropy and the second law; Clausius inequality; Principle of increase of entropy; Entropy change in (i) adiabatic process (ii) free expansion (iii) cyclic process (iv) isobaric process; TdS diagram of a Carnot cycle; Entropy and disorder 4 hours

Unit - 3

Thermodynamic potentials

Internal Energy; Enthalpy; Helmholtz free energy; Gibbs free energy and their significance; Maxwell's thermodynamic relations and their significance; TdS relations; Energy equations and Heat Capacity equations; Third law of thermodynamics (Nernst Heat theorem) 4 hours

Phase transitions of the first order

Melting, vaporization and sublimation; Condition of equilibrium of phases in terms of Gibbs potential; Clausius-Clapeyron equation - elevation of boiling point, depression of freezing point; Equilibrium between phases - triple point 3 hours

Classical Equilibrium Statistical Mechanics

Specification of the state of the system; Phase space; Microstates and macrostates; Thermodynamic probability and its calculation; Basic postulates; Entropy and thermodynamic probability; Calculation of temperature from statistical mechanics 6 hours

Unit - 4

Low Temperature Physics

Methods of producing low temperatures: (i) Joule Thomson (Joule Kelvin / Throttling / Porous plug) experiment, Joule Thomson Coefficient, inversion temperature (ii) Adiabatic demagnetization - working and theory 4 hours

Liquefaction of gases

Cascade process; Regenerative cooling coupled with Joule Thomson cooling; Adiabatic expansion with Joule Thomson cooling (qualitative) 3 hours

Black Body Radiation

Block body radiation and its spectral energy distribution; Kirchhoff s law, Stefan-Boltzmann's law, Wien's displacement law, Rayleigh-Jeans law, Derivation of Planck''s law, Radiation pressure (qualitative), Solar constant and its determination; Estimation of the surface temperature of the sun 6 hours

References:

1. Fundamentals of Physics- R Resnik, D Halliday and KS Krane, Asian Books Private Limited, New Delhi, 1994
2. Heat and Thermodynamics- M M Zemansky,(International Edition) McGraw Hill New Delhi, 1981
3. Heat & Thermodynamics, MW Zemansky & RH Dittman, McGraw Hill Book company, Fifth Print 1986
4. Heat & Thermodynamics - Brij Lal and N Subramanyam, S Chand & Co, NewDelhi, 1985
5. Concepts of Physics Vol (1) and (2)- HC Verma, Bharathi Bhavan Publications, New Delhi, 1996

6. Heat and Thermodynamics - DS Mathur, S Chand & Co, New Delhi, 5th Edition (2004)
7. Heat, Thermodynamics & Stastical Mechanics, BrijLal & Subramanyam, S Chand & Company
8. Thermodynamics & Statistical Physics, Sharma & Sarkar, Himalaya Publishing House, Third Edition(1991)
9. Thermodynamics, Kinetic theory & Statistical Thermodynamics, FWSears & GLSalinger, Narosa Publishing House (Third Edition)
10. Mechanics & Thermodynamics, GBasavaraju & Dipan Ghosh, TMH Publishing Limited, New Delhi, 1984
11. Fundamentals of Classical Thermodynamics, Gordon J V Wylen & Richard E Sonntag, Wiley Eastern Limited
12. Thermal Physics, S C Garg, R M Bansal & C K Ghosh, TMH Publishing Company, New Delhi
13. Statistical Physics, Thermodynamics & Kinetic theory, V S Bhatia, SChand & Co, (5th Edition-1993)
14. Perspectives of Modern Physics, Arthur Beiser, McGraw hillo Book Company, Fourth Edition, 1987
15. Thermal Physics, BKAgarwal, Lokbharathi Publications, Allahabad, Third Edition 1993
16. Elements of Statistical Mechanics, Kamal Singh & SPSingh, SChand & Co, (IInd Edition, 1992)
17. Theory & Problems of Thermodynamics, Michael M Abbott & Hendrick C Van Ness, Schaum's Outline Series, McGraw Hill International Book Company, Singapore
18. University Physics-Sears & MW Zemansky
19. Fundamentals of Statistical and Thermal Physics -F Reif
20. Mechanics and Thermodynamics, C Basavaraju and D Ghosh
21. Thermal Physics- *C* Kittel
22. Thermal Physics - Chakraborthy

Phy-202: Practical Physics – II

List of Experiments

1. Specific heat by Newton's law of cooling
2. Specific heat of water using a thermistor
3. Thermal conductivity of a bad conductor by Lee's and Charlton's method
4. Thermal conductivity of rubber
5. Determination of thermal conductivity of a good conductor by Angstrom method / Searle's method
6. Thermal behavior of a torch filament
7. γ- by measuring velocity of sound- using CRO
8. Verification of Newton's law of cooling and Stefan's law of radiation
9. Determination of Stefan's constant by emissivity method
10. Calibration of thermocouple for Temperature measurement
11. Verification of Clausius-Clapeyron equation using pressure cooker
12. Determination of Solar constant
13. Monte Carlo experiment & error analysis
14. Verification of Maxwell's distribution of velocity
15. Maxwellian distribution of velocities for electron using EZ81vacuum diode
16. Dice experiment – to study statistical nature of results

Note: A minimum of EIGHT (8) experiments must be performed

References:

1. B Saraf etc, - Physics through experiments, Vikas Publications
2. DP Khandelwal – A Laboratory Manual of Physics for Undergraduate Classes, Vani Publications
3. Advanced Practical Physics for Students – Worsnop & Flint, Methuen & Co, London
4. An Advanced Course in Practical Physics, D Chattopadhyay, PC Rakshit, B Saha, New Central Book Agency (P) Limited, Kolkata, Sixth Revised Edition, 2002
5. BSC, Practical Physics, CL Arora, S Chand & Co, New Delhi, 2007 Revised Edition

Syllabus for III Sem B.Sc. (Physics)
Phy-301: Electricity and Magnetism

Unit - 1

Electric field and potential Review:
Electrostatic field and intensity; Electrostatic potential; Relation between field and potential 1 hour
Electric dipole, potential and intensity at any point due to a dipole 2 hours

Network theorems
Superposition theorem; Thevenin's theorem; Norton's theorem; Maximum power transfer theorem (for dc circuits - with problems) 5 hours

Magnetic fields and forces
Motion of charged particles in a magnetic field; Magnetic force on a current carrying conductor; Force and torque on a current loop, Concept of dead beat; Theory of a BG, Determination of high resistance by leakage 5 hours

Unit - 2

Source of magnetic field
Magnetic field due to moving charge, Biot and Savart's law; Magnetic field due to a straight current carrying conductor; Force between parallel conductors; Definition of ampere; Magnetic field of a circular loop; Theory of HTG; Field on the axis of a solenoid, Ampere's law, Application of Ampere's law to straight wire, solenoid and toroid 10 hours

Electromagnetic induction
Faraday's laws; Lenz's law; Expression for induced emf; motional emf; eddy currents and applications 3 hours

Unit - 3

Transient currents
Self inductance; Magnetic field energy stored in an inductor; Growth and decay of current in RC, LR, LCR circuits; Damped, under-damped and over-damped conditions 5 hours

Scalar and vector fields
Gradient of a scalar function; Relation between field and potential; Divergence and curl product rules; Line, surface and volume integrals; Fundamental theorem of divergence and curl (statements only) 3 hours

Electromagnetic waves
Maxwell's equations (derivation and significance); Electromagnetic waves - Derivation of wave equation, Velocity of em waves, Relation between refractive index and permittivity, Plane em waves, Energy and momentum, Significance of Poynting vector 5 hours

Unit - 4

Alternating current

Alternating current circuits, Resistance, Reactance and Impedance; LCR series and parallel circuits (vector method), Resonance, Power in ac circuits, Representation of sinusoids by complex numbers, ac bridge - Maxwell bridge 6 hours

Thermoelectricity

Seebeck effect; Thermoelectric series; Neutral temperature; Laws of thermoelectricity; Peltier effect, Demonstration of Peltier effect, Peltier coefficient; Thomson effect, Demonstration of Thomson effect, Thomson coefficient; Theory of thermoelectric circuits using thermodynamics; Thermoelectric diagrams and uses; Applications of thermoelectricity - Boy's radio micrometer, thermopile and thermoelectric pyrometer 7 hours

References:

1. Electricity and magnetism by Brij Lal and N Subrahmanyam, Rathan Prakashan Mandir, Nineteenth Edition, 1993
2. Principles of Electronics by VK Mehta and Rohit Mehta, SChand & Company, Eleventh Edition, 2008
3. Feynman Lecture series, VolII, RPFeynnman et al, Narosa Publishing House, New Delhi
4. Electricity & Magnetism, NSKhare & SSSrivastava, AtmaRam & Sons, New Delhi
5. Electricity & Magnetism, DLSehgal, KLChopra, NKSehgal, SChand & Co, Sixth Edition, (1988)
6. Electricity & Electronics, DCTayal, Himalaya Publishing House, Sixth Edition(1988)
7. Basic Electronics & Linear Circuits, NN Bhargava, DC Kulshrestha & SC Gupta, TMH Publishing Company Limited, 28th Reprint,1999
8. Fundamentals of Physics by Halliday, Resnick and Walker, Asian Books Private Limited, New Delhi, 5th Edition,1994
9. Introduction to Electrodynamics by DJ Griffiths
10. Electromagnetism by BB Laud
11. Electrical Networks, Theraja
12. Electrical Networks, Malvino

Phy - 302: Practical Physics – III

List of Experiments

1. To find L and C by equal voltage method
2. Energy consumption in an electrical circuit - to find power factor
3. Resonance in LCR series circuit
4. Resonance in LCR parallel circuit
5. Mirror galvanometer- figure of merit
6. High resistance by leakage using BG
7. Thermoelectric circuit - find Seebeck coefficients
8. Study of thermo emf as a heat pump
9. Black box - identify & measure R, L and C
10. Verification of Thevenin's theorem
11. Verification of Superposition theorem
12. Verification of maximum power transfer theorem
13. Maxwell's impedance bridge
14. Desauty's bridge
15. Anderson's bridge

Note: A minimum of EIGHT (8) experiments must be performed

References:

1. Physics through experiments, BSaraf etc, Vikas Publications
2. Advanced practical physics, Chauhan & Singh, Pragathi Publications
3. Practical Physics, DChattopadhyaya et al, Central Publications
4. An Advanced Course in Practical Physics, D Chattopadhyay, PC Rakshit, B Saha, New Central Book Agency (P) Limited, Kolkata, Sixth Revised Edition, 2002
5. Practical Physics, TCTayal

Syllabus for IV Sem B.Sc. (Physics)

Phy401: Physical Optics, Lasers and Fibre optics

Unit - 1

Wave Theory

Huygens' wave theory of light; Huygens' Principle; Construction Huygens' wave front; Laws of reflection and refraction using spherical wave front at a plane surface 3 hours

Interference – a Review:

Coherent sources and their production; Conditions for observing interference; Conditions for constructive and destructive interference 1 hour

Coherent sources by wavefront division

Biprism-theory and working, experiment to determine wavelength; Effect of thin film in the path of one of the beams; Calculation of thickness of the film 5 hours

Coherent sources by amplitude division:

Interference at thin films - reflected and transmitted light Colours of thin films; Theory and experiment of air wedge; Theory and experiment of Newton's rings 4 hours

Unit - 2

Diffraction - Fresnel diffraction

Division of wavefront into Fresnel's half period zones; Theory of rectilinear propagation using these ideas; Construction and working of Zone plate; Comparison of Zone plate with lens; Theory of diffraction at a straight edge 7 hours

Fraunhoffer diffraction

Theory of single slit diffraction; Theory of grating - normal and oblique incidence - Experimental determination of wavelength; Discussion of Dispersive power; Resolution, Rayleigh's criterion; Expression for resolving power of grating and telescope; Comparison of prism and grating spectra 6 hours

Unit - 3

Lasers

Introduction; Spontaneous and stimulated emission; Einstein's coefficients and optical amplification; Population inversion; Main components of a laser; Lasing action; Ruby Laser - construction and working - energy level diagram; He-Ne Laser - construction and working - energy level diagram; Fiber Laser - Master Oscillator power amplifier; Solid State Laser - construction and working; Applications of Lasers - Holography, bloodless surgery (principles only) 7 hours

Polarization

Review of plane polarized light and method of production; Double refraction at crystals; Huygens' explanation of double refraction; Theory of retarding plates - Quarter wave plates and Half wave plates; Production and detection of linearly , elliptically and circularly polarized light; Optical activity - Fresnel's explanation Laurent's half shade polarimeter 6 hours

Unit - 4

Optical Fibres

Optical fiber-principle, description and classification; Why glass fibers? Coherent bundle; Numerical aperture of fiber; Attenuation in optical fibers - limit Multimode optical fibers; Ray dispersion in multi-mode step index fibers; Dispersion due to material; Dispersion and maximum bit rates; Fiber optic sensors 8 hours

Modes in fibres

Introduction; Modes in fibers Symmetric step index planar waveguide TE modes; Propagation constants; Field distribution; Physical understanding of modes; TM modes of a symmetric step index planar wave guide 5 hours

References:

1. Introduction to Modern Optics, Tata McGraw Hill Publications (2009)
2. Fundamentals of Physics by Halliday, Resnick and Walker, Asian Books Private Limited, New Delhi, 5th Edition, 1994
3. A K Ghatak and K Thyagarajan, Contemporary Optics, Macmillan
4. Jenkins and White, Optics, McGraw Hill
5. Optics, BrijLal and Subramaniam, SChand & Company, 22nd Edition, 1994
6. Principles of Optics, B K Mathur, Gopal Printing Press, Kanpur, 6th Edition,1996
7. An Introductions to LASERS-Theory & Applications, MNAvadhanulu, SChand & Co, (2001)
8. Introduction to Fibre Optics, Ajoy Ghatak & K Thyagarajan, Cambridge University Press, First Edition Reprint,2002
9. Optical Fibre Communications, Gerd Keiser, McGraw Hill, 3rd Edition, 2000
10. Fibre Optic Communication, DCAgarwal, Wheeler Publications, Second Edition Reprint,1996
11. Optics, Klein and Furtak, Wiley Publications
12. B B Laud, Lasers, Wiley Eastern

Phy-402: Practical Physics – IV

List of Experiments

1. Verification of Brewster's law
2. Refractive index of a liquid by parallax method
3. Biprism – determination of wavelength of light
4. Air wedge – determination of thickness of object
5. Newton's rings – determination of radius of curvature of lens surface
6. Diffraction grating in minimum deviation position
7. Diffraction grating in normal incidence position
8. Resolving power of telescope
9. Diffraction at straight edge
10. Polarimeter – determination of specific rotation of a solution
11. Diffraction of LASER at a wire
12. Measurement of numerical aperture of an optical fibre
13. Fraunhoffer diffraction of LASER at single slit
14. Diffraction of LASER at graduations of a metal scale

Note: A minimum of EIGHT (8) experiments must be performed

References:

1. An Advanced Course in Practical Physics , D Chattopadhyay, PC Rakshit, B Saha, New Central Book Agency (P) Limited, Kolkata, Sixth Revised Edition, 2002
2. Practical Physics, Experiments with He-Ne laser, RSSirohi
3. Advanced Practical Physics, Wirsnop & Flint
4. BSc, Practical Physics, CLArora, SChand & Company, New Delhi, Revised Edition, 2007
5.

General References:

1. College Physics, Raymond A Serway & Jerry S Faughn, Thomson Brooks / Cole (sixth Edition)
2. Scientia Physics, Avinash Sharma, CBS Publishers & Distributors, New Delhi(First Edition 2000)
3. Principles of Physics, Frederick J Bueche & David A Jerde, McGraw Hill Inc (Sixth Edition)
4. University Physics, Hugh D Young & Roger A Fredman, Addision Wesley Longman Inc, (Ninth Edition) , Pinnacle Distributors, New Delhi
5. Understanding Physics, Karen Cummings, Priscilla Laws, Edward Redish & Patrick Cooney, Wiley India, 2006 Reprint
6. College Physics, Serway

Phy 501: Quantum Mechanics, Solid State Physics and Electronics

Unit -1

Quantum mechanics

Failures of classical physics: black body spectrum- atomic spectra- photoelectric effect; de-Broglie's hypothesis and de-Broglie's wavelength; Davisson-Germer's experiment; Phase velocity-Group velocity and relation between them; Heisenberg's uncertainty principle; γ-ray microscope experiment; wave function and its interpretation; Schrodinger's equation(time dependent, stationary states); Mention of time independent equation; Eigen values-Eigen functions

Applications: Particle in one-dimensional box- mention of three dimension; Harmonic Oscillator (Qualitative) 13 hours

Unit - 2

Solid State Physics

Free electron theory of metals: Electrical conductivity- classical theory (Drude-Lorentz model); Thermal conductivity; Wiedemann - Franz's law; Density of states for free electrons; Fermi-Dirac distribution function and Fermi energy; Expression for Fermi energy and Kinetic energy at absolute zero and above absolute zero (no derivation) 5 hours

Band theory of solids: Elementary ideas regarding formation of energy bands; Bloch equations; One dimensional Kroning-Penney model; Density of states; Effective mass; Energy gap 4 hours

X ray diffraction: Bragg's law; Types of crystals; Miller indices; the structure of NaC1 and KC1 crystals; Continuous and characteristics X-ray spectra; Mosley's law 4 hours

Unit - 3

Electronics

Operational amplifier:

Introduction to the concept of feedback; Operational amplifiers; Ideal characteristics; The basic op-amps circuits; Inverting amplifier, Non-inverting amplifier; Applications of op-amp-summer, integrator, differentiator, voltage follower

Basic logic concepts

Logic states; Voltage range of high and low logic states; Number codes; Hexadecimal representation; BCD; signed numbers; Arithmetic l's and 2's complement; Gray code; Logic gates and truth tables; OR gate, AND gate; Inverter (the NOT function); NAND and NOR; exclusive OR; exclusive NOR; RS and D flip flops 13 hours

References:

1. Fundamentals of Physics, Volume-II, Quantum Mechanics & Nuclear Physics, DKChaturvedi & SKGupta, RChand & Co, New Delhi, 8th Edition, 2005
2. Introductory Quantum Mechanics, YRWaghmare, Eurasia Publishing House, New Delhi(1989)
3. Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles – Eisenberg & Resnick, John Wiley & Sons
4. Concepts of Modern Phyiscs, Beiser, Third Edition (Student Edition) New Delhi(1981)
5. Introduction to Modern Physics, HSMani & GKMehta, West Press,1989
6. Modern Physics, Murugesan, SChand & Co, 1996
7. The Feymann Lectures on Physics Volume-III, Narosa Publishing House, New Delhi
8. Elements of Modern Physics, SHPatil, TMH, New Delhi(1984)
9. Principles of Modern Physics, APFrench, John Wiley, London 1958
10. Modern Physics , SNGhoshal- Part –I & Part –II, SChand & Co, 1996
11. Solid State Pysics, CKittel, Wiley Eastern Limited, 5th Edition
12. Solid State Physics, AJDekker, Macmillan India Limited (1986)

Phy 502: Practical Physics V

List of Experiments

1. CRO & its applications to (a) determine voltage of AC
   (b) determine frequency of AC
   (c) study Lissajous patterns
2. Digital GATEs - Half adder& Full adder circuits
3. Opamp Inverter and Summing Amplifiers
4. Opamp differentiator and integrator
5. Inverting and non inverting amplifier
6. Flip flops
7. Analysis of X-ray photograph
8. Realisation of AND and OR gates
9. Determination of Fermi energy
10. Energy gap of semi conductor
11. Transistor as a switch and an active device
12. Determination of thermal conductivity of a material
13. Resistivity of a material by four probe method
14. Semi conductor temperature sensor

Note: A minimum of EIGHT (8) experiments must be performed

References:

1. An Advanced Course in Practical Physics , D Chattopadhyay, PC Rakshit, B Saha, New Central Book Agency (P) Limited, Kolkata, Sixth Revised Edition, 2002
2. IGNOU-Practical physics manual
3. Experiments in physics, Saraf
4. Advanced practical physics, Raj kumar & Madan Lal
5. Practical Physics, SPSingh
6. Electronics, Bhaargava Et al, TTTI
7. A lab course in electronics, Ramalingom & Raghupalan

Phy 601: Atomic Physics, Molecular Physics Astrophysics and Nuclear Physics

Unit -1

Atomic physics

A brief account of the Somerfeld atomic model (qualitative), Electron spin, Stern-Gerlach experiment, space quantization, the vector model of the atom, spin -orbit interaction, Fine structure of spectral lines The Pauli's exclusion principle and the electronic configuration of atoms The Normal Zeeman Effect (Quantum Theory), Millikan's oil drop experiment with theory 7 hours

Molecular spectra

Pure rotational Spectrum and selection rules, vibrational spectrum and selection rules, Rotational-vibrational spectrum, scattering of light- Tyndall, Rayleigh and Raman's scattering Experimental study of Raman Effect, Quantum theory of Raman effect, Applications of Raman effect 6 hours

Unit - 2

Astrophysics

Distances in astronomy- light year and parsec, solar and sidereal time scales, Luminosities, apparent and absolute magnitude scales, Stellar spectra, spectral classification, H-R diagram, Temperatures of stars, Equations of stellar structure, linear density model for stars, Formation of stars (qualitative), Energy production in stars, the proton-proton cycle, Evolution of stars (qualitative), End stages of stars- white dwarfs, neutron stars and black holes (qualitative), Optical telescopes- their types, characteristics and applications 13 hours

Unit -3

Nuclear physics

Rutherford's theory of alpha scattering (assuming the path to be hyperbolic)

Alpha decay: Gamow's theory of alpha decay, Q-value of alpha decay, Exact energy of alpha particle emitted, characteristics of alpha spectrum Geiger - Nuttal law

Beta decay: Types of beta decay (electron, positron decay and electron capture) Characteristics of beta spectrum and Pauli's neutrino hypothesis Detectors : Variation of ionization current with applied voltage in a gas counter, GM Counter

Particle accelerators: Cyclotron, Tandem Van-de-Graff

Nuclear reactions: Types of Nuclear reactions Conservation laws Expression for Q value of a nuclear reaction - Endoergic and Exoergic reactions, threshold energy 13 hours

References:

1. Fundamentals of Physics, Volume-II, Quantum Mechanics & Nuclear Physics, DKChaturvedi & SKGupta, RChand & Co, New Delhi, (Eight Edition 2005)
2. Introduction to Atomic & Nuclear Physics, HEWhite, Affiliated East Weat Press Private Limited, 1968
3. Atomic Spectra, HGKaun, Ongmans,1952
4. Atomic Physics, JBRajam, SChand & Co, 1979

5. Modern Physics, Murugesan, SChand & Co, 1996
6. Elements of Modern Physics, SHPatil, TMH, New Delhi(1984)
7. Principles of Modern Physics, APFrench, John Wiley, London 1958
8. Modern Physics , SNGhoshal- Part –I & Part –II, SChand & Co, 1996
9. Physics of the Atom, Wehr et al, McGraw Hill
10. Nuclear Physics, Rajkumar, Campus Books International, New Delhi, 1st Edition2005

Phy 602: Practical physics VI

1. Specific charge of electron by Thomson's method
2. Ionization potential of Xenon
3. Study of Solar spectrum – determination of Rydberg constant
4. Analysis of band spectra
5. Analysis of rotational spectra
6. Analysis of rotational – vibrational spectra
7. Study of Hydrogen spectrum – determination of Rydberg constant
8. Determination of Sommerfeld's fine structure constant by measuring fine structure separation of Na doublets
9. Characteristics of GM counter
10. Verification of Inverse square law using GM counter
11. Analysis of sun spots
12. To draw HR diagram and determine physical properties of stars
13. Analysis of stellar spectrum
14. Determination of distance by parallax method

Note: A minimum of EIGHT (8) experiments must be performed

References:

1. IGNOU-Practical physics manual
2. Experiments in physics, Saraf
3. Advanced practical physics, SPSingh
4. Experiments in Modern Physics, Melissnos
5. An Advanced Course in Practical Physics , D Chattopadhyay, PC Rakshit, B Saha, New Central Book Agency (P) Limited, Kolkata, Sixth Revised Edition, 2002

Phy 503A: (elective) Astrophysics

Unit-I: Time and Co-ordinate Systems in Astronomy

The celestial co-ordinates, The Azimuth system, The equatorial system, aspects of sky at a given place, The Ecliptic System, Galactic System. Apparent solar time, mean solar time, sidereal time, Universal time system. Conversion of co-ordinates and time with practical examples. Effect of refraction and aberration on the coordinates, Types and characteristics of telescopes. 13 hours

Unit – II: Stellar Physics

Helio-centric parallax, Definition of parsec (pc), astronomical unit (AU), light year (ly) and their relations. Spectra of stars, stellar classification. Stellar luminosity and magnitude scales, Radius of a star. Mass – Luminosity relationship and expression for lifetime of a star. H-R diagram, Main sequence stars and their general characteristics. Star formation and main sequence evolution, White dwarfs, Pulsars, Neutron stars and Black holes, Variable stars, Supernova explosion, Chandrasekhar limit, Virial Theorem. 13 hours

Unit – III: The Solar System

The surface of the sun, solar atmosphere, chromosphere, corona, solar interior structure, solar rotation, sunspots, the active sun. Properties of interior planets and exterior planets, comets, asteroids, meteorites, Oort cloud. Theories of formation of solar system. 13 hours

Reference Books

1. Baidyanath Basu Introducction to Astrophysics Printice Hall 1997.
2. Chandrasekhar S An introduction to the study of stellar structure, Dover Publica
3. Thorne K S Stellar Evolution
4. Karltunen H, Oja H and others Fundamental Astronomy, Springer Verlag 1987
5. Unsold A, The New Cosmos, Springer
6. Introduction to Modern Astrophysics, Carroll & Ostlie, Pearson Eduction

Phy 504A: (elective) Practical Astrophysics

1. Parallax Method – Distance of objects using trigonometric parallax
2. H R Diagram - Physical Properties of stars
3. Determination of temperature of a star (artificial)
4. Analysis of stellar spectra
5. Analysis of sunspot photographs & solar rotation period
6. Mass luminosity curve – Estimation of mass of a star
7. Mass of binary stars
8. Data Mining
9. Energy gap of semiconductor.
10. Thermal conductivity of a conductor.
11. Weidman-Franz law.
12. Dipole moment of organic liquid.
13. Curie – Weiss law.
14. Study of LASER diode – to draw its characteristics.

Phy 503B: (elective) SOLID STATE DEVICES

Unit I

Review of Kronig penny model, formation of forbidden energy gap, distinction between metals semiconductors and insulators Derivation of expression for electron and hole concentration in intrinsic semiconductors and show that their product is square of charge concentration, Derivation of expressions carrier concentration in extrinsic semiconductors (n-type and p-type. Formation of P-N junction, depletion region (diffusion of electron and holes when the junction is not externally biased). Biased P-N junction, variation of width of the depletion region, drift & diffusion current derivation of expression for diode current. 13 hours

Unit II: Electronic-devices

BJT (their behaviour under different bias and characteristics.) the active mode of the BJT, LOAD LINE different types of bias, JFET MOSFET characteristics and behaviour and 1-2 applications. 7 hours

Thyristors - SCR its characteristics and use as rectifier TRIAC Gate-turn off switch (GTO) DIAC and UJT with a 1-4 applications. 6 hours

Unit III: Opto electronic Devices

Light absorption and emission. Photo diodes, solar cells, LED, LDR and LASER DIODES, Physics of all these devices. 4 hours

Spintronics-elements –physics of spintronics application-giant magneto-resistance sandwich structure (GMR). 3 hours

Superconductivity - Elementary ideas - BCS theory (Qualitative only) Josephson – transistor – SQID -High temperature superconductors and applications of superconductivity. 6 hours

Reference Books

1. Physics of semiconducting devices---Tze
2. Solid state devices---Streetman

Phy 504B: (elective) practical Solid state Devices

1. Study of IR-LED
2. SCR—characteristics
3. LED characteristics.
4. Study of LDR – to draw its characteristics.
5. Study of Photo diode – to draw its characteristics.
6. Study of Solar cell – to draw its characteristics.
7. MOSFET characteristics.
8. Study of LASER diode – to draw its characteristics.
9. Energy gap of semiconductor.
10. Thermal conductivity of a conductor.
11. Weidman-Franz law.
12. Dipole moment of organic liquid.
13. Curie – Weiss law.
14. Analysis of stellar spectra
15. Analysis of sunspot photographs & solar rotation period

Note: A minimum of eight experiments must be performed in the practical paper.

Phy 503C: (elective) CONDENSED MATER PHYSICS

Unit I: Liquid state

What is Condensed matter physics? Different states of matter. 1 hour

The liquid state: Intermolecular forces, short range order. Adhesive and cohesive forces, surface tension, surfactants and Pickering emulsions. Consequences of a surface tension: angle of contact and wetting, pressure difference across curved liquid surfaces (derivation), the shape of a meniscus, capillary ascent (derivation), interfacial surface tension, drop-weight method with necessary theory. Factors affecting surface tension. 7 hours

Viscosity: Coefficient of viscosity, streamline and turbulent flow, critical velocity, Reynold's number and its significance, Poiseuille's formula (derivation). Motion of a body in a viscous medium, Stokes law, expression for terminal velocity (derivation), factors affecting viscosity. 5 hours

Unit II: Solid Crystals and magnetism

Solid Crystals: Forces between atoms and molecules, equilibrium distance, different types of bonding in solids (ionic, covalent, molecular, metallic, hydrogen, hydroxyl, ion-dipole) and corresponding characteristics, calculation of cohesive energy of an ionic crystal (derivation). Crystal structures, periodicity and long range order, review of Bravais lattices, calculation of packing fraction for hcp, simple cubic, fcc, bcc and diamond structures. 6 hours

Magnetism: Magnetic dipole moment, atomic magnetic moment, Bohr magneton (derivation), magnetic moment due to electron spin, Langevin's theory of diamagnetism (qualitative), LS Coupling, g factor, quantum theory of paramagnetism- Curie's Law (derivation), Origin of Ferromagnetism- Wiess domain theory (qualitative), Curie-Wiess law, Hysteresis loop and related terms, energy loss due to hysteresis (derivation), Ferrimagnetic order, spinel structure, Antiferromagnetic order. 7 hours

Unit III: Liquid crystals and Dielectrics

Liquid crystals: Discovery, structure and classification: Thermotropic (nematic, cholesteric, smectics-A and C, discotic, banana) and lyptropic (lamellar and hexagonal). Typical liquid crystalline compounds, sequence of transitions, re-entrance, homogeneous and homeotropic alignments. Properties: anisotropy in dielectric constant, electrical conductivity, magnetic susceptibility, refractive index and elasticity. Applications: construction and operation of twisted nematic display, thermography and other applications. 6 hours

Dielectrics: Static dielectric constant, polarisability (electronic, ionic and orientation), calculation of Lorentz field (derivation), Clausius-Mosotti equation (derivation), complex dielectric constant and dielectric loss (qualitative), dielectric breakdown, electrostriction (qualitative), electrets. Piezo electric effect, cause, examples and applications. Ferroelectric crystals, hysteresis loop for polarization and related terms. 7 hours

Reference Books

1. P.M. Chaikin and T.C. Lubensky, **Principles of Condensed Matter Physics** , Cambridge University Press ,[2000]
2. M. Kleman and O. Lavrentovich, **Soft Matter Physics: an introduction** (Springer, 2003);
3. C. Kittel, **Introduction to Solid State Physics**, 7th edition, John Wiley and Sons, New York, 1996.
4. A. J. Dekker, **Solid State Physics**, Macmillan India Ltd.
5. P.G. deGennes, and J. Prost, **The Physics of liquid crystals**, 2nd edition, Clarendon press, Oxford, 1993.
6. S. Chandrasekhar, **Liquid crystals**, 2nd edition, Cambridge university press, 1992.
7. G. Vertogen and W.H. de Jeu, **Thermotropic liquid crystals, Fundamentals**, Springer-Verlag, Berlin, 1987.

Phy 504C: (elective) practical CONDENSED MATER PHYSICS

1. Surface and interfacial surface tension by drop-weight method.
2. Surface tension by capillary ascent, variation with concentration of salt.
3. Coefficient of viscosity by Stokes method.
4. Coefficient of viscosity using Poiseuille's formula.
5. Hysteresis loop for iron and finding energy loss.
6. Measurement of dielectric constant.
7. Dipole moment of organic liquid.
8. Determination of dielectric constant.
9. Determination of electrical conductivity.
10. Determination of refractive index of liquid crystals.
11. Determination of elasticity of liquid crystals.
12. Study of piezo electric effect.
13. Parallax Method – Distance of objects using trigonometric parallax
14. H R Diagram - Physical Properties of stars
15. Determination of temperature of a star (artificial)

Note: A minimum of eight experiments must be performed in the practical paper.

Phy 503D: (Elective) NUCLEAR MODELS

Unit I: Basic properties of nuclei and nuclear forces.

Proton-electron hypothesis of the nucleus. Discovery of neutron. Proton-neutron model of the nucleus. Spin and magnetic moment of deuteron. Characteristics of nuclear forces. Nuclear mass – Aston's mass spectrograph. Binding energy and variation with mass. Ground state wave function of deuteron using square well potential (l=0 in the radial equation) - relationship between the range and depth of potential. Yukawa's idea of exchange forces. 13 hours

Unit II: Shell model

Basis for nuclear shell model- magic numbers. Single particle energy levels for harmonic oscillator potential – orbital and radial quantum numbers. Explanation of magic numbers. Spin-orbit interaction- splitting of energy levels. Prediction of spin-parity for the ground state for few simple nuclei like ^{16}O, ^{17}O and ^{18}O. 13 hours

Unit III: Collective model

Liquid-drop model of nucleus. Semi-empirical mass formula-stability of nuclei against β-decay. Mass parabola. Explanation of fission. Nuclear deformations –prolate and oblate shapes. Rotational energy levels –moment of inertia. Vibrational energy levels. 13 hours

Books for reference:

1. B.L. Cohen : Concepts of Nuclear Physics (McGraw-Hill Book Co., New York, 1971).
2. K.S. Krane : Introductory Nuclear Physics (John Wiley & Sons, New York, 1987).
3. W.E. Meyerhof : Elements of Nuclear Physics (McGraw Hill Book Co., New York, 1971).
4. S.N. Ghoshal : Atomic and Nuclear Physics, Vol. II (S. Chand & Co., New Delhi, 1994)
5. D. Halliday, R. Resnick and J. Walker : Fundamentals of Physics - Extended Sixth Edition (John Wiley & Sons, New York, 2002)
6. Evans – The Atomic Nucleus
7. R.R. Roy & B.P. Nigam – Nuclear physics Theory and experiment (Wiley Eastern Limited – New Delhi, 1986.)
8. Herald Enge – Introduction to Nuclear Physics
9. Irving Kaplan – Nuclear Physics

Phy 504D : (elective) Practical NUCLEAR MODELS

1. SCR—characteristics
2. LED characteristics.
3. Study of LDR – to draw its characteristics.
4. H R Diagram - Physical Properties of stars
5. Determination of temperature of a star (artificial)
6. Analysis of stellar spectra
7. Analysis of sunspot photographs & solar rotation period
8. Study of Photo diode – to draw its characteristics.
9. Study of Solar cell – to draw its characteristics.
10. Hysteresis loop for iron and finding energy loss.
11. Measurement of dielectric constant.
12. Dipole moment of organic liquid.
13. Determination of dielectric constant.
14. Determination of electrical conductivity.
15. Surface and interfacial surface tension by drop-weight method.
16. Surface tension by capillary ascent, variation with concentration of salt.

Note: A minimum of eight experiments must be performed in the practical paper.

Phy 503 E: (elective) ATOMIC & MOLECULAR SPECTROSCOPY

Unit – I: Atomic Structure

Orbital magnetism and anomalous Zeeman Effect. The spinning electron. The spin orbit interaction and magnetic effects. Exchange symmetry and the exclusion principal. Electron interactions and screening effects. The periodic table. X ray spectra and Moseley's law

13 hours

Unit – II: Molecular structure

Bonding Mechanism. Molecular rotation and vibration. Molecular spectra. Electron sharing and the covalent bond. Bonding in complex molecules. 13 hours

Unit – II: Statistical physics

Quantum Statistics. Wave function and Bose-Einstein Condensation and Pauli's Exclusion Principle. Bose-Einstein and Fermi- Dirac Distribution, Application of BE Statistics - Black Body Radiation. Einstein's Theory of Specific Heat. An application of FD Statistics -The free electron gas theory of metals. Laser manipulations of atoms. 13 hours

Reference

Modern Physics: Serway/Moses/Mayer

Phy 504 E: (elctive) practical ATOMIC & MOLECULAR SPECTROSCOPY

1. Fine structure constant
2. Vibration Band structure of Iodine molecule
3. Absorption Band of KMnO4
4. Rotation Spectra of Nitrogen molecule
5. Rotation Vibration spectra of HBr
6. Verification of Moseley's law.
7. H R Diagram - Physical Properties of stars
8. Determination of temperature of a star (artificial)
9. Analysis of stellar spectra
10. Analysis of sunspot photographs & solar rotation period
11. SCR—characteristics
12. LED characteristics.
13. Study of LDR – to draw its characteristics.
14. Determination of dielectric constant.
15. Determination of electrical conductivity.

Note: A minimum of eight experiments must be performed in the practical paper.

Phy 603A: (elective) Atmospheric and Space Science

Unit – I: Earth's atmosphere

Composition of atmosphere, Weather and Climate, Vertical structure of the atmosphere, Fixed and variable gases, Mechanism of production and destruction of atmospheric constituents, Troposphere, Stratosphere, Mesosphere and Thermosphere. Temperature variation in the atmosphere, Lapse rate, Stability and Instability of atmosphere. Thermodynamics of dry air & moist air, Virtual temperature, Potential temperature, Scale height, Hydrostatic balance, Change of pressure with altitude, Total potential energy of air column, Green house effect, Climate change. 13 hours

Unit – II: Scattering

Aerosols: Sources, size, distribution, transport and residence time.

Scattering: Characteristics of scattering, Types of scattering, Rayleigh scattering by air molecules, MIE scattering, Angular and total scattering cross sections. Optical thickness and atmospheric turbidity. Interaction of solar radiation with the atmosphere, Atmospheric transmittance, Solar radiation with the atmosphere, Lambertz-Beer's law. Scattering, Absorption and Extinction.

Waves: Atmospheric waves - Sound waves, Gravity waves, Rossby waves, Kelvin waves (Qualitative). 13 hours

Unit – III: Space Science

Orbit fundamentals, Derivation of Kepler's laws of planetary motion from Newton's laws, Solution to two - body problem-elliptical, Parabolic and hyperbolic orbits, Lagrange's solutions, Lagrange's planetary equations, artificial satellites, Types of orbits-geostationary and synchronous orbits, sun synchronous orbits and satellites, Weightlessness and artificial gravity, Forces acting on artificial satellites, Remote sensing applications, Evaluation of remote sensing in India. Microwave remote sensing. 13 hours

References :

1. The physics of Atmosphere 3rd Edition – John Houghton, Cambridge University Press 2002, Paperback, 320 pp.
2. An Intoduction to Atmosphere Physics David. G. Andrews, Cambridge University Press, 2000.
3. An Introduction to Dynamic Meteorlogy 4th Edition. James R Holton, Elsevier and Academic Press, 2004.
4. Meteorolgy for Scientists and Engineers, 2nd Edition. Ronald. B. Stull Brookes/Cole, 2000
5. Steven. A. Ackerman, John. A. knox Meteorlogy – Understanding the Atmosphere Thomson/Brooks/Cole – 2003.
6. Ghadekar S R, Meteorology, Agromet Publishers, Nagpur-10 (Maharashtra), 2001.
7. R R Daniel (Editor), Concepts in space Science, Universities press, ISRO, 2002.
8. D S Mathur, Mechanics, Vikas Publishing House, 1978.

Phy 604A : (elective) practical Atmospheric and Space Science

1. Temperature of air- by using Thermograph (Bimetallic type)- Plotting the graph of temperature Vs time.
2. Temperature of air- inside the room/ outside the room for 3 Hours duration.
3. Measurement of humidity and diurnal variation in absolute humidity - by using Hair hygrometer.
4. Relative humidity.
5. Wind speed.
6. Solar constant- determination.
7. Aerosol experiment.
8. Radiation measurement.
9. Evaporation experiment.
10. Effect of albedo on temperature.
11. Thermal conductivity of glass.
12. Thermal conductivity of bad conductor by Forbes method.
13. Conductivity of solution of various concentrations by Kohlrousch's method.
14. Study of elastic deformation in metals.
15. Transistor amplifier.
16. Study of crystals defects by analyzing photographs.

Note: A minimum of eight experiments must be performed in the practical paper.

Phy 603B: (Elective) INSTRUMENTATION TECHNOLOGY

Unit I: qualities of measurements

Introduction: Performance characteristics; Static characteristics Error in Measurements; Types of error; Sources of error; Dynamic characteristics; Statistical analysis; Standard Atomic Frequency and time standards; Electrical standards; Graphical presentation of measurements as a distribution. 3 Hours

Laser instrumentation

Introduction to Lasers, application of Lasers for measurement of distance, applications of Lasers to measurement of velocity, Laser Doppler anemometer. 2 hours

Measuring instruments

Output power meter field strength meter, Stroboscope, phase meter, vector impedance meter, Q meter, LCR bridge, R X meter automatic bridges, transistor tester, Megger analogue PH meter. 4 hours

Bridges

Wheat stones Bridge, Kelvin Bridge, practical Kelvin's double bridge, bridge controlled circuits, digital read out bridges, microprocessor controlled bridges, AC bridges, capacitance bridge, HAY's bridge, Scherring bridge, Wien's bridge, Wagner's bridge, Wagner's earth connection, resonance bridge, types of detectors, precautions to be taken when using a bridge. 4 Hours

Unit II: Transducers

Electrical transducers, Selecting a transducers, Resistive transducers, restive position transducers, strain gauges, resistance thermometer, thermistor, inductive transducers, pressure inductive transducers, differential output transducers, linear variable differential transducers, Capacitive transducer, load cell, piezo electric transducers, photo electric transducers, photo voltaic cell, semi conductor photo diode, the photo transistor, thermo electric transducers, mechanical flow meter, magnetic flow meters, turbine flow meter, measurements of thickness using beta gauge. 13 Hours

Unit III: Microprocessors

Introduction: Microcomputers, Microprocessors; Microprocessor Architecture, Stacks, Resources sharing Memory access and transfer, Interrupts, Microprocessor software. Microprocessor accessories: Random access memory, Read only memory, Erasable programmable read only memory, Non-Volatile memory, Tri state logic, status decoders, input - output devices, interface logic.

Internal structure of a microprocessor: Functional description of INTEL 8080A, operational sequences, description of input output pins for 8085A, timing and synchronization of interfaces, functional description of 8085A, microprocessor kits. 8 hours

Oscilloscope:

Introduction, Basic principle, CRT features, Block diagram of oscilloscope, Simple CRO, Vertical amplifier, Horizontal deflecting system, High frequency CRT, Dual beam CRO, Dual trace oscilloscope, Measurement of frequency by Lissagous's method, Spot wheel method,

Gear wheel method checking of diodes, Basic measurement of capacitance and inductance, Oscilloscope as a bridge null detector, Use of Lissajous figure for phase measurement, Applications of oscilloscope in operation. 5 hours

Phy 604B: (elective) Practical INSTRUMENTATION TECHNOLOGY

1. Determination of the area of an optical flat by measuring the length and breadth using Calipers and using travelling microscope, comparative study; error calculation, percentage and relative error.
2. Determination of the external diameter of a capillary tube using a screw gauge and travelling microscope, comparative study; error calculation, percentage and relative error.
3. Microprocessor: Program to add and subtract 2 eight bit numbers
4. Microprocessor: Program to load four internal resistors with data from four consecutive locations in memory using direct addressing mode and indirect addressing mode.
5. Microprocessor: Program to convert 8 bit BCD into decimal equivalent and vice-versa.
6. Microprocessor based bridges
7. Characteristics of CRT
8. Measuring frequency and phase shift using oscilloscope
9. LCR bridge, RX meter
10. Wheat stone's bridge.
11. Kelvin's bridge
12. AC bridges, Capacitance bridges
13. Capacitance comparison bridges
14. AC bridges, Inductance bridges
15. Inductance comparison bridges
16. Maxwell's bridge, HAY's bridge
17. Thermistor

Note: A minimum of eight experiments must be performed in the practical paper.

TEXT BOOKS

1. Electronic Instrumentation, H.S. Kalsi, Tab McGraw Hill (1995).
2. Instrumentation; Devices and systems, C.S. Ragan, G.R. Sarma and V.S.V. Mani Tata McGraw Hill (1983).
3. Instrumentation measurements and analysis, B.C. Nakra and K.K. Choudhry Tata McGraw Hill (1985).
4. Electronic and Electrical measurements, A.K. Sawhney, Khanna publishers.

BOOKS FOR REFERENCE

1. Digital electronics and microprocessors; Problems and solutions, R.P. Jain Tata McGraw Hill (1987).
2. Transducers and Display systems, B.S. Sonde, Tata McGraw Hill (1979).
3. Digital principles and applications, Malvino and Leach, Tata McGraw Hill (1993).
4. Microprocessor architecture, Programming and applications with 8085/8080A, R.S. Gaonkar, Wiley Eastern (1991)
5. Electric instruments and measurements, A Text book Manual, ZBAR McGraw Hill International editions.

Phy 603 C: (elective) MATERIAL SCIENCE.

Unit I: Crystal Geometry, Structure and Defects

Crystals, Single crystals, Whiskers, Lattice points and space lattice, Unit cells, Primitive cells, Crystal systems, Crystal structure for metallic elements, Atomic radius, Density of crystals, Directions, Lattice planes and Miller indices. Methods of determination of crystal structure (a) Laue's method (b) powder method. Crystal growth and methods, Defects or imperfection in crystals point imperfection, Line defects or dislocation, Surface and grain Boundary defects, Stacking faults, Volume imperfection, Liquid crystals, Anisotropy.

10 hours

Electron theory of metals: Metallic bonding, Drude-Lorentz theory, Free electron theory of gas in one and three dimensional box, Band theory of solids, Brillion zones, Distinction between conductors, insulators and semiconductors. 3 hours

Unit II: Diffusion in Solids

Types of diffusion, Diffusion mechanisms, Diffusion coefficient, (Fick's law of diffusion), Factors affecting diffusion coefficient and experimental determination, Kirkendal-effect. Application of diffusion, Problems. 3 hours

Alloys

Introduction, alloy system, solid solution, Hume-Rothery's rules, phase diagram, Gibbs phase rule, cooling curves (time- temperature curves), construction of phase diagram, Lever rule. Ceramic and ternary phase diagrams. Application of phase diagrams. 4 hours

Phase transformation

Nucleation (mechanism of phase transformation), I-order and II-order phase transitions Gibb's energy, order parameter, Homogeneous and heterogeneous nucleation, nucleation and growth. 3 hours

Deformation of metals

Introduction, Elastic and Plastic deformation, Mechanism of deformation, Deformation by slip. 3 hours

Unit III: Thermal properties of material

Introduction, heat capacity, Vibrational heat capacity, Dulong-Petit's law (classical model). Einstein's theory, Deby's theory (Qualitative), mechanism of heat conduction in metals, ceramics, Polymers and Superconductors. 4 hours

Optical properties of metals

Introduction of radiation with material, Atomic transition, Absorption and emission of photons in metals, Optical properties of non-metals, Refractive index, Absorption coefficient, Luminescence, Photo conductivity. 3 hours

Superconductivity

Experimental observation, Critical field, Meissner effect, Types of super conductors. Phenomenological theories of super conductivity, London equations, B.C.S theory of super conductivity (qualitative), Application of super conductivity, Josephson effect (AC and DC)

3 hours

Nano materials: Introduction, Graphites, Fullerenes, Carbon nanotubes (CNT), Nano wires, Carbon nanocones, Hackelites, Production methods for CNT, Mechanical and Electric properties of CNT, Nano material advantages. 3 hours

References:

1. Material Science and Engineering. William D. Callister, Adapted by R.Balasubramaniam, Wiley Publications.
2. Physical Foundation of Material Science, Gottesten Springer, Wiley Publication
3. Material science. S.L. Kakani, Amit kakani, New Age International Publication, 1st Editon-2004
4. Rudiments of Material Science. S.D. Pillai, New Age International Publication, 2nd Edition- 2007
5. Material Science and Engineering. V. Raghavan, PHI- 2002
6. Foundation of material science and Engineering. Smith, 3rd Edition, Mc Graw Hill 1997

Phy 604C: (elective) practical material science

1. Determination of energy gap of semiconductor by four probes method.
2. Determination of crystal constant by analysis of diffraction pattern obtained by Laue's method.
3. Determination of crystal constant by analysis of diffraction pattern obtained by powder method.
4. Thermal conductivity of glass.
5. Thermal conductivity of bad conductor by Forbes method.
6. Conductivity of solution of various concentrations by Kohlrousch's method.
7. Study of elastic deformation in metals.
8. Transistor amplifier.
9. Measurement of heat capacity of metals.
10. Ultrasonic interferometer- measurement of ultrasonic velocity in solids by Piezo-electric technique.
11. Calibration of spectrometer using a channel spectrometer by Edser-Buttler method and hence determine the thickness of mica sheet.
12. Measurement of refractive index of non metals.
13. Study of crystals defects by analyzing photographs.
14. Study of Hysterisis curve using C.R.O.
15. Determination of Fermi energy of copper.
16. Experiments on polymers, nano materials and optical fibres are suggested

Note: A minimum of eight experiments must be performed in the practical paper.

Phy 603 D: (elective) NUCLEAR REACTIONS & ELEMENTARY PARTICLES.

Unit I: Nuclear reactions-1

Review of artificial transmutation, Types of nuclear reactions, Q-values, and conservation laws in nuclear reactions. 3 hours

Elastic collision (non-relativistic) in laboratory system, Elastic collision (non-relativistic) in center-of-mass (CM) system, Total kinetic energy, Threshold energy, Relation between angles in the two systems. 10hours

Unit II: Nuclear reactions-2

Nuclear cross sections for elastic scattering and reactions, Partial-wave approach, Compound nuclear reactions, Estimation of lifetime of levels from the width of resonances, Breit-Wigner formulae (no derivations), Idea of partial widths. 8 hours

Direct reactions and kinematics, Stripping and pickup reactions, Angular distributions, Comparison of features of compound and direct reaction models. 5 hours

Unit III: Fundamental particles

Classification of interactions and the standard model

Gravitational, Electro-magnetic, Weak (nuclear) and strong (nuclear) interactions, the standard model, Classification of elementary particles into Leptons, Quarks, and Mediators (or force particles). 2 hours

Leptons

Electron, mu meson, tau meson and the associated neutrinos. Lepton quantum number and antiparticles. 2 hours

Quarks : Properties of heavier mesons and baryons, Related quantum numbers such as strangeness, The eight-fold way. Anomalous properties of neutron and proton leading to the idea that they are not 'elementary particles'. 3 hours

The quark model of Gellmann and Zweig, Types of quarks, Flavour and colour, Quarks as constituents of proton and neutron, Qualitative explanation of spin and magnetic moment of nucleons. 3 hours

Mediators : Mediators for electro-magnetic, weak and strong interactions, Photon, W and Z bosons, and gluons. 3 hours

Books for reference:

1. B.L. Cohen : Concepts of Nuclear Physics (McGraw-Hill Book Co., New York, 1971).
2. K.S. Krane : Introductory Nuclear Physics (John Wiley & Sons, New York, 1987).
3. W.E. Meyerhof : Elements of Nuclear Physics (McGraw Hill Book Co., New York, 1971).
4. S.N. Ghoshal : Atomic and Nuclear Physics, Vol. II (S. Chand & Co., New Delhi, 1994)
5. D. Halliday, R. Resnick and J. Walker : Fundamentals of Physics - Extended Sixth Edition (John Wiley & Sons, New York, 2002)
6. Evans – The Atomic Nucleus
7. R.R. Roy & B.P. Nigam – Nuclear physics Theory and experiment (Wiley Eastern Limited – New Delhi, 1986.)
8. Herald Enge – Introduction to Nuclear Physics
9. Irving Kaplan –Nuclear Physics

Phy 604D: (elective) practical NUCLEAR REACTIONS & ELEMENTARY PARTICLES

1. Determination of half life of K^{40} using GM counter.
2. Determination of absorption coefficient of aluminium.
3. Resolving time of a G M counting set up
   (a) single source method & (b) double source method.
4. Random nature of radioactive decay.
5. Study of back scattering of beta-particles.
6. Determination of energy gap of semiconductor by four probes method.
7. Study of elastic deformation in metals.
8. Transistor amplifier.
9. Measurement of heat capacity of metals.
10. Ultrasonic interferometer- measurement of ultrasonic velocity in solids by Piezo-electric technique.
11. Wheat stone's bridge.
12. Kelvin's bridge.
13. AC bridges, Capacitance bridges.
14. Capacitance comparison bridges.

Note: A minimum of eight experiments must be performed in the practical paper.

Phy 603 E: (Elective) MOLECULAR BIO PHYSICS

Unit I

Introduction

Levels of molecular organization, Amino acids, electrolytes, composition and primary structures of proteins, Nucleic acids, Adenylates, Chirality of Biological molecules, carbohydrates, lipids, cofactors, vitamins, hormones. 4 hours

Protein structures

Conformational analysis and forces that determine protein structures, geometries, potential energy calculations, phi, psi, omega and chi values of dihedral angles in proteins, hydrogen bonding, disulphide bands, hydrophobic interactions, structure of water, relationship between the primary and 3D structure of proteins, antibodies and antigens, fibrous proteins. 5 hours

Physics of bio membranes

Structure and conformational properties of cell membranes, Singer and Nicholson model, integral proteins in membranes, conformational variations during ion transport, monitoring membrane potentials, Signal transduction and molecular reception (qualitative). 4 hours

Unit II

Biophysical techniques

Rayleigh scattering, ultra centrifugation, viscometry. Electron microscopy, STM, AFM, luminescence (fluorescence & phosphorescence), Calorimetry, DSC, Mass spectrometry, LC-MS, MALDI-TOF, Voltage Clamp and Patch Clamp (measurements of membrane potentials). 6 hours

Spectroscopic techniques

X-ray Spectroscopy: structure determination via single crystal diffraction, fiber diffraction; Neutron diffraction. XAFS. NMR spectroscopy (structure determination). Optical Activity, CD, UV, IR, Laser Raman, ESR/EPR. 7 hours

Unit III

Biomolecular interactions

Association of macromolecules, supramolecular interactions, protein-protein interactions, protein-nucleic acid interactions, lipid/membrane-protein interactions. 5 hours

Molecular dynamics

Molecular mechanics and dynamics, theoretical principles and its importance towards insilico simulations, results of molecular dynamics calculations and their implications to biological function. 5 hours

Physics of nerve impulse

The axon and the nerve impulse, propagation of the nerve impulse, generation of nerve impulse, ionic channels, synoptic transmission. 3 hours

TEXT BOOKS

1. Biophysical Chemistry by Cantor R. and Schimmel P.R.
2. Physical Biochemistry by David Freifelder (N H Freeman and Company).
3. Biophysical Principles of Structure & Function by Fred M. Snell & Sidney Shulman.
4. Introduction to Protein Structure by Carl Branden and John Tooze. (Garland Publishing).
5. Proteins - Structure & Molecular Properties by Creighton.
6. Physical Chemistry: Principles and Applications in Biological Sciences by Tinoco and others (Prentice Hall, 4th Ed).

REFERENCE BOOKS

1. Biophysics – An Introduction by Cotterill, Wiley Student Edition
2. Foundations of Biophysics by A.L. Stanford.
3. Principles of protein structure by G Schulz and R H Schrimer (Springer Verlag)
4. Principles of nucleic acid structure by Sanger (Springer Verlag)
5. Introduction to Protein Science by Arthur M Lesk (OUP)
6. Biological Spectroscopy by J.D. Campbell and R. A. Dwek

Phy 604E: (Elective) practical molecular bio physics

1. Determination of energy gap of semiconductor by four probes method.
2. Study of elastic deformation in metals.
3. Transistor amplifier.
4. Measurement of heat capacity of metals.
5. AC bridges, Capacitance bridges.
6. Capacitance comparison bridges.
7. Calibration of spectrometer using a channel spectrometer by Edser-Buttler method and hence determine the thickness of mica sheet.
8. Measurement of refractive index of non metals.
9. Study of crystals defects by analyzing photographs.
10. Determination of half life of K^{40} using GM counter.
11. Determination of absorption coefficient of aluminium.
12. Resolving time of a G M counting set up
    (a) single source method & (b) double source method.
13. Measurement of refractive index of non metals.
14. Study of crystals defects by analyzing photographs.
15. Study of Hysterisis curve using C.R.O.
16. Determination of Fermi energy of copper.

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