



**MODIFIED CBCS CURRICULUM OF
PHYSICS HONOURS PROGRAMME**

SUBJECT CODE = 55

FOR UNDER GRADUATE COURSES UNDER RANCHI UNIVERSITY



Implemented from
Academic Session 2017-2020



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(Dr Ashe kate shukla)

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COURSE STRUCTURE FOR UNDERGRADUATE 'HONOURS' PROGRAMME

Table AI-1: Distribution of 140 Credits [*wherever there is a practical there will be no tutorial and vice –versa.]

Course	Papers	Credits	
		Theory + Practical	Theory + Tutorial
I. Core Course	(CC 1 to 14)		
Theory	14 Papers	14X4=56	14X5=70
Practical/Tutorial*	14 Papers	14X2=28	14X1=14
II. Elective Course (EC)			
A. Discipline Specific Elective	(DSE 1 to 4)		
Theory	4 Papers	4X4=16	4X5=20
Practical/ Tutorial*	4 Papers	4X2=8	4X1=4
B. Generic Elective/ Interdisciplinary	(GE 1 to 4)		
Theory	4 Papers	4X4=16	4X5=20
Practical/ Tutorial*	4 papers	4X2=8	4X1=4
III. Ability Enhancement Compulsory Courses (AECC)			
1. English/ Hindi Communication/ NH+MB/ Business Communication for Commerce	1 Paper	1X2=2	1X2=2
2. Environmental Science	1 Paper	1x2=2	1x2=2
3. Skill Enhancement Course of the Core Course opted	(SEC 1 & 2) 2 Papers	2X2=4	2X2=4
Total Credit = 140			= 140

Table AI-1.1: Course structure for B.Sc./ B.A./ B.Com.(Hons. Programme)

Semester	Honours (Core Courses) 14 Papers	Allied (Elective Courses) 8 Papers	Ability Enhancement (Compulsory Courses) 4 Papers	Total Credits
Sem-I	C-1, C-2 (6+6=12 Credits)	GE-1 (06 Credits)	Eng Comm./ Hindi/ NH + MB (02 Credits)	20 Credits
Sem-II	C-3, C-4 (6+6=12 Credits)	GE-2 (06 Credits)	EVS (02 Credits)	20 Credits
Sem-III	C-5, C-6, C-7 (6+6+6=18 Credits)	GE-3 (06 Credits)	SEC-1 (02 Credits)	26 Credits
Sem-IV	C-8, C-9, C-10 (6+6+6=18 Credits)	GE-4 (06 Credits)	SEC-2 (02 Credits)	26 Credits
Sem-V	C-11, C-12 (6+6=12 Credits)	DSE-1, DSE-2 (6+6=12 Credits)		24 Credits
Sem-VI	C-13, C-14 (6+6=12 Credits)	DSE-3, DSE-4 (6+6=12 Credits)		24Credits

Total = 140 Credits

COURSES OF STUDY FOR UNDERGRADUATE 'B. Sc. Hons' PROGRAMME

Table AI-2 Subject Combinations allowed for B. Sc. Hons. Programme (140 Credits)

Honours/Core Subject CC 14 Papers	Discipline Specific Elective Subject DSES 4 Papers	Skill Enhancement Course SEC 2 Papers	Compulsory Course AECC 1+1=2 Papers
Physics	Physics Specific	SEC in Physics	Language Communication + EVS

Table AI-2.1 Semester wise Examination Structure for Mid Sem & End Sem Examinations:

Sem	Core Honours, Allied DSE, Compulsory AECC Courses		Examination Structure		
	Code	Papers	Mid Semester Theory (F.M.)	End Semester Theory (F.M.)	End Semester Practical/ Viva (F.M.)
I	C1	Mathematical Physics-I + Lab	15	60	50
	C2	Mechanics .+ Lab	15	60	
	GE1	Refer Table AI-2.3 of the Syllabus of Subject opted			
	AECC	Language Communication		100	
II	C3	Electricity and Magnetism + Lab	15	60	50
	C4	Waves and Optics. + Lab	15	60	
	GE2	Refer Table AI-2.3 of the Syllabus of Subject opted			
	AECC	EVS		100	
III	C5	Mathematical Physics II + Lab	15	60	75
	C6	Thermal Physics + Lab	15	60	
	C7	Digital Systems and Applications + Lab	15	60	
	GE3	Refer Table AI-2.3 of the Syllabus of Subject opted			
	SEC 1	Elementary Computer Application Software + Lab		100	
IV	C8	Mathematical Physics III + Lab	15	60	75
	C9	Elements of Modern Physics + Lab	15	60	
	C10	Analog Systems and Applications + Lab	15	60	
	GE4	Refer Table AI-2.3 of the Syllabus of Subject opted			
	SEC 2	Electrical Circuit Network Skills + Lab		100	
V	C11	Quantum Mechanics and Applications + Lab	15	60	50
	C12	Solid State Physics + Lab	15	60	
	DSE 1	Nuclear and Particle Physics + Tutorial	25	75	
	DSE 2	Classical Dynamics + Tutorial	25	75	
VI	C13	Electromagnetic Theory + Lab	15	60	50
	C14	Statistical Mechanics + Lab	15	60	
	DSE 3	Dissertation			75 + 25 Viva
	DSE 4	Experimental Techniques + Lab	15	60	25

**Table AI-2.2 Generic Subject Papers for B. Sc. Hons. Programme (140 Credits);
All Four Papers of Any One Subject to be opted leaving aside the papers of Hons. Subject:**

Generic Elective Subject GE 4 Papers	Generic Elective Courses for Arts Stream (GE will be other than Core Subject opted)			
	Semester I GE1	Semester II GE2	Semester III GE3	Semester IV GE4
Chemistry	Atomic Structure, Bonding, General Org Chem & Aliphatic Hydrocarbons + Lab	Chemical Energetics, Equilibria & Functional Gp Org Chemistry-I + Lab	Chem. of s- and p-block elements, States of matter and Chem. Kinetics + Lab	Chem. of d-block elements, Molecules of Life + Lab
Mathematics	Object oriented Programming in C++ + T	Econometrics + T	Information Security + T	Application of Algebra + T
Geology	Essentials of Geology + Lab	Rocks & Minerals + Lab	Fossils & their Applications + Lab	Earth Resources + Lab

Table AI-2.3 Semester wise Structure for End Sem Examinations of Generic Elective in Physics:

Sem	Core Honours, Allied DSE, Compulsory AECC Courses		Examination Structure		
	Code	Papers	Mid Semester Theory (F.M.)	End Semester Theory (F.M.)	End Semester Practical/ Viva (F.M.)
I	GE1	Mechanics + Lab		75	25
II	GE2	Electricity and Magnetism + Lab		75	25
III	GE3	Thermal & Statistical Physics + Lab		75	25
IV	GE4	Waves and Optics + Lab		75	25

SEMESTER I

4 Papers**Total 100 x 4 = 400 Marks****I. ABILITY ENHANCEMENT COMPULSORY COURSE (AECC)**

(Credits: Theory-02)

Any One Compulsory Language Communication Prescribed by Ranchi University:

English Communication/ Hindi Communication / NH + MB Communication

(Refer AECC Curriculum of Ranchi University)**II. GENERIC ELECTIVE (GE 1)**

(Credits: 06)

All Four Papers (One paper to be studied in each semester) of any One Subject to be opted other than the Honours Subject. Refer Content from the Syllabus of Opted Generic Elective Subject.

III. CORE COURSE –C 1:

(Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) + 25 (Pr 3Hrs)=100**Pass Marks: Th (MSE +ESE) = 30 + Pr ESE =10*****Instruction to Question Setter for******Mid Semester Examination (MSE):***

There will be **two** group of questions. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type** three questions of five marks each, out of which any two are to answer.

End Semester Examination (ESE):

There will be **two** group of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.

Note: There may be subdivisions in each question asked in Theory Examinations.

MATHEMATICAL PHYSICS-I**Theory: 60 Lectures**

The emphasis of course is on applications in solving problems of interest to physicists.

The students are to be examined entirely on the basis of problems, seen and unseen.

Calculus:

Recapitulation: Intuitive ideas of continuous, differentiable, etc. functions and plotting of curves.
Approximation: Taylor and binomial series (statements only). First Order Differential Equations and Integrating Factor

(6 Lectures)

Second Order Differential equations: Homogeneous Equations with constant coefficients. Wronskian and general solution. Statement of existence and Uniqueness Theorem for Initial Value Problems.

Particular Integral for typical source terms like polynomials, exponential, sine, cosine etc and their combinations.

(12 Lectures)

Calculus of multivariable functions: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers.

(6 Lectures)

Vector Calculus:

Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their geometrical interpretation. Scalar and Vector fields.

(5 Lectures)

Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities.

(10 Lectures)

Vector Integration: Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications (no rigorous proofs). Dirac Delta function and its properties:

(14 Lectures)

Orthogonal Curvilinear Coordinates:

Orthogonal Curvilinear Coordinates. Expression for Gradient, Divergence, Curl and Laplacian in orthogonal curvilinear co-ordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.

(7 Lectures)

Reference Books:

- Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier.
- An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning
- Differential Equations, George F. Simmons, 2007, McGraw Hill.
- Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
- Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book
- Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning
- Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
- Essential Mathematical Methods, K.F.Riley & M.P.Hobson, 2011, Cambridge Univ. Press
- Mathematical Physics, B. D. Gupta.
- Mathematical Physics, B. S. Rajput.
- Mathematical Physics, H. K. Dass.
- Mathematical methods in Physics, E. Butkov.
- Mathematical methods in Physics, Potter and Goldberg.

PHYSICS PRACTICAL- C 1 LAB**60 Lectures**

The aim of this Lab is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics.

- *Highlights the use of computational methods to solve physical problems*
- *The course will consist of lectures (both theory and practical) in the Lab*
- *Evaluation done not on the programming but on the basis of formulating the problem*
- *Aim at teaching students to construct the computational problem to be solved*
- *Students can use any one operating system Linux or Microsoft Windows*

Topics	Description with Applications
Introduction and Overview	Computer architecture and organization, memory and Input/output devices
Basics of scientific computing	Binary and decimal arithmetic, Floating point numbers, algorithms, Sequence, Selection and Repetition, single and double precision arithmetic, underflow & overflow emphasize the importance of making equations in terms of dimensionless variables, Iterative methods
Errors and error Analysis	Truncation and round off errors, Absolute and relative errors, Floating point computations.
Review of C & C++ Programming fundamentals	Introduction to Programming, constants, variables and data types, operators and Expressions, I/O statements, scanf and printf, c in and c out, Manipulators for data formatting, Control statements (decision making and looping statements) (<i>If-statement. If-else Statement. Nested if Structure. Else-if Statement. Ternary Operator. Goto Statement. Switch Statement. Unconditional and Conditional Looping. While Loop. Do-While Loop. FOR Loop. Break and Continue Statements. Nested Loops</i>), Arrays (<i>1D & 2D</i>) and strings, user defined functions, Structures and Unions, Idea of classes and objects
Programs:	Sum & average of a list of numbers, largest of a given list of numbers and its location in the list, sorting of numbers in ascending descending order, Binary search
Random number generation	Area of circle, area of square, volume of sphere, value of π
Solution of Algebraic and Transcendental equations by Bisection, Newton Raphson and Secant methods	Solution of linear and quadratic equation, solving $\alpha = \tan\alpha$; $I = I_0 [(\sin\alpha)/\alpha]^2$ in optics
Interpolation by Newton Gregory	Evaluation of trigonometric functions e.g. $\sin\theta$, $\cos\theta$, $\tan\theta$, etc.

Forward and Backward difference formula, Error estimation.	
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Also attempt some problems on differential equations like:

1. Solve the coupled first order differential equations

$$\frac{dx}{dt} = y + x - \frac{x^3}{3}$$

$$\frac{dy}{dt} = -x$$

for four initial conditions $x(0) = 0, y(0) = -1, -2, -3, -4$. Plot x vs y for each of the four initial conditions on the same screen for $0 \leq t \leq 15$.

2. The ordinary differential equation describing the motion of a pendulum is

$$\vartheta'' = -\sin(\vartheta)$$

The pendulum is released from rest at an angular displacement α i.e. $\vartheta(0) = \alpha, \vartheta'(0) = 0$. Use the RK4 method to solve the equation for $\alpha = 0.1, 0.5$ and 1.0 and plot ϑ as a function of time in the range $0 \leq t \leq 8\pi$. Also, plot the analytic solution valid in the small ϑ ($\sin \vartheta \approx \vartheta$).

3. Solve the differential equation:

$$x^2 \frac{d^2 y}{dx^2} - 4x(1+x) \frac{dy}{dx} + 2(1+x)y = x^3$$

with the boundary conditions: at $x = 1, y = (1/2)e^2, dy/dx = -(3/2)e^2 - 0.5$, in the range $1 \leq x \leq 3$. Plot y and dy/dx against x in the given range. Both should appear on the same graph.

Referred Books:

- Introduction to Numerical Analysis, S.S. Sastry, 5th Edn. , 2012, PHI Learning Pvt. Ltd.
- Schaum's Outline of Programming with C++. J. Hubbard, 2000, McGraw Hill Pub.
- Numerical Recipes in C: The Art of Scientific Computing, W.H. Press et al, 3rd Edn. , 2007, Cambridge University Press.
- A first course in Numerical Methods, U.M. Ascher & C. Greif, 2012, PHI Learning.
- Elementary Numerical Analysis, K.E. Atkinson, 3rd Edn. , 2007, Wiley India Edition.
- Numerical Methods for Scientists & Engineers, R.W. Hamming, 1973, Courier Dover Pub.
- An Introduction to computational Physics, T.Pang, 2nd Edn. , 2006, Cambridge Univ. Press

IV. CORE COURSE- C 2:

(Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) + 25 (Pr 3Hrs)=100**Pass Marks: Th (MSE +ESE) = 30 + Pr ESE =10*****Instruction to Question Setter for*****Mid Semester Examination (MSE):**

There will be **two** group of questions. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type** three questions of five marks each, out of which any two are to answer.

End Semester Examination (ESE):

There will be **two** group of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.

Note: There may be subdivisions in each question asked in Theory Examinations.

MECHANICS**Theory: 60 Lectures****Fundamentals of Dynamics:**

Reference frames. Inertial frames; Review of Newton's Laws of Motion. Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse. Momentum of variable-mass system: motion of rocket.

(6 Lectures)**Rotational Dynamics:**

Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation.

(12 Lectures)**Elasticity:**

Elastic constants and interrelation between them. Twisting torque on a Cylinder or Wire and twisting couple.

(5 Lectures)**Flexure of beam:**

Bending of beam, Cantilever.

(3 Lectures)**Surface Tension:**

Ripples and Gravity waves, Determination of Surface Tension by Jaeger's and Quinke's methods. Temperature dependence of Surface Tension.

(6 Lectures)**Fluid Motion:**

Kinematics of Moving Fluids, velocity profile: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube and the corrections.

(2 Lectures)

Central Force Motion:

Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution.. Kepler's Laws. Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS). Physiological effects on astronauts.

(6 Lectures)

Oscillations:

Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor.

(8 Lectures)

Special Theory of Relativity:

Galilean transformations; Galilean invariance. Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Lorentz contraction. Time dilation. Relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass-energy Equivalence. Relativistic Doppler effect. Relativistic Kinematics. Transformation of Energy and Momentum. Energy-Momentum Minkowski space and Four Vector.

(12 Lectures)

Reference Books:

- An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
- Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
- Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
- Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning.
- Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
- Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

Additional Books for Reference

- Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
 - University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
 - Physics for scientists and Engineers with Modern Phys., J.W. Jewett, R.A. Serway, 2010, Cengage Learning
 - Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.
 - A textbook of General Physics, Edser
 - Fluid mechanics, Kaufmann
 - A treatise of hydromechanics, Basant and Ramsay.
 - Oscillations and waves, Satya Prakash.
 - A textbook of oscillation, waves and Acoustics, M. Ghosh and D. Bhattacharya
-

PHYSICS PRACTICAL-C 2 LAB**60 Lectures**

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
2. To study the random error in observations.
4. To study the Motion of Spring and calculate (a) Spring constant, (b) g and (c) Modulus of rigidity.
5. To determine the Moment of Inertia of a Flywheel.
6. To determine g and velocity for a freely falling body using Digital Timing Technique
7. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
9. To determine the Modulus of Rigidity of a bar by method of bending.
10. To determine the elastic Constants of a wire by Searle's method.
11. To determine the value of g using Bar Pendulum.
12. To determine the value of g using Kater's Pendulum.

Reference Books

- Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
 - Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
 - A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal.
-

SEMESTER II

4 Papers**Total 100 x 4 = 400 Marks****I. ABILITY ENHANCEMENT COMPULSORY COURSE (AECC)**

(Credits: Theory-02)

Marks : 100 (ESE: 3Hrs) =100**Pass Marks Th ESE = 40***Instruction to Question Setter for**End Semester Examination (ESE):**There will be **objective type test** consisting of hundred questions of 1 mark each. Examinees are required to mark their answer on **OMR Sheet** provided by the University.***AECC – ENVIRONMENT STUDIES****Theory: 30 Lectures****Unit 1 : Introduction to environmental studies**

- Multidisciplinary nature of environmental studies;
- Scope and importance; Concept of sustainability and sustainable development.

(2 lectures)**Unit 2 : Ecosystems**

- What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems :
 - a. Forest ecosystem
 - b. Grassland ecosystem
 - c. Desert ecosystem
 - d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

(2 lectures)**Unit 3 : Natural Resources : Renewable and Non-renewable Resources**

- Land resources and land use change; Land degradation, soil erosion and desertification.
- Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- Water : Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state).
- Energy resources : Renewable and non renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

(5 lectures)**Unit 4 : Biodiversity and Conservation**

- Levels of biological diversity : genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots
- India as a mega-biodiversity nation; Endangered and endemic species of India
- Threats to biodiversity : Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity.

- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

(5 lectures)

Unit 5 : Environmental Pollution

- Environmental pollution : types, causes, effects and controls; Air, water, soil and noise pollution
- Nuclear hazards and human health risks
- Solid waste management : Control measures of urban and industrial waste.
- Pollution case studies.

(5 lectures)

Unit 6 : Environmental Policies & Practices

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture
- Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

(4 lectures)

Unit 7 : Human Communities and the Environment

- Human population growth: Impacts on environment, human health and welfare.
- Resettlement and rehabilitation of project affected persons; case studies.
- Disaster management : floods, earthquake, cyclones and landslides.
- Environmental movements : Chipko, Silent valley, Bishnois of Rajasthan.
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

(3 lectures)

Unit 8 : Field work

- Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.
- Visit to a local polluted site---Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds and basic principles of identification.
- Study of simple ecosystems---pond, river, Delhi Ridge, etc.

(Equal to 4 lectures)

Suggested Readings:

- Raziuddin, M., Mishra P.K. 2014, *A Handbook of Environmental Studies*, Akanaksha Publications, Ranchi.
- Mukherjee, B. 2011: *Fundamentals of Environmental Biology*. Silverline Publications, Allahabad.
- Carson, R. 2002. *Silent Spring*. Houghton Mifflin Harcourt.
- Gadgil, M., & Guha, R. 1993. *This Fissured Land: An Ecological History of India*. Univ. of California Press.
- Gleeson, B. and Low, N. (eds.) 1999. *Global Ethics and Environment*, London, Routledge.
- Gleick, P. H. 1993. *Water in Crisis*. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
- Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll. *Principles of Conservation Biology*. Sunderland: Sinauer Associates, 2006.
- Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. *Science*, 339: 36--37.
- McCully, P. 1996. *Rivers no more: the environmental effects of dams*(pp. 29--64). Zed Books.
- McNeill, John R. 2000. *Something New Under the Sun: An Environmental History of the Twentieth Century*.
- Odum, E.P., Odum, H.T. & Andrews, J. 1971. *Fundamentals of Ecology*. Philadelphia: Saunders.
- Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. *Environmental and Pollution Science*. Academic Press.
- Rao, M.N. & Datta, A.K. 1987. *Waste Water Treatment*. Oxford and IBH Publishing Co. Pvt. Ltd.
- Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. *Environment*. 8th edition. John Wiley & Sons.
- Rosencranz, A., Divan, S., & Noble, M. L. 2001. *Environmental law and policy in India*. Tripathi 1992.
- Sengupta, R. 2003. *Ecology and economics: An approach to sustainable development*. OUP.
- Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi.
- Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. *Conservation Biology: Voices from the Tropics*. John Wiley & Sons.
- Thapar, V. 1998. *Land of the Tiger: A Natural History of the Indian Subcontinent*.
- Warren, C. E. 1971. *Biology and Water Pollution Control*. WB Saunders.
- Wilson, E. O. 2006. *The Creation: An appeal to save life on earth*. New York: Norton.
- World Commission on Environment and Development. 1987. *Our Common Future*. Oxford University

II. GENERIC ELECTIVE (GE 2):

(Credits: 06)

All Four Papers (One paper to be studied in each semester) of any One Subject to be opted other than the Honours Subject. Refer Content from the Syllabus of Opted Generic Elective Subject.

III. CORE COURSE -C 3:

(Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) + 25 (Pr 3Hrs)=100	Pass Marks: Th (MSE +ESE) = 30 + Pr ESE =10
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Instruction to Question Setter for***Mid Semester Examination (MSE):***

There will be two group of questions. Group A is compulsory and will contain five questions of very short answer type consisting of 1 mark each. Group B will contain descriptive type three questions of five marks each, out of which any two are to answer.

End Semester Examination (ESE):

There will be two group of questions. Group A is compulsory and will contain two questions. Question No.1 will be very short answer type consisting of ten questions of 1 mark each. Question No.2 will be short answer type of 5 marks. Group B will contain descriptive type five questions of fifteen marks each, out of which any three are to answer.

Note: *There may be subdivisions in each question asked in Theory Examinations.*

ELECTRICITY AND MAGNETISM**Theory: 60 Lectures****Electric Field and Electric Potential**

Electric field: Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry.

(6 Lectures)

Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson Equations and their solutions. The Uniqueness Theorem. Potential and Electric Field due to a dipole. Force and Torque on a dipole.

(6 Lectures)

Electrostatic energy of system of charges. Conductors in an electrostatic Field. Surface charge and force on a conductor. Parallel-plate capacitor. Capacitance of an isolated conductor.

(10 Lectures)**Dielectric Properties of Matter:**

Electric Field in matter. Polarization, Polarization Charges. Electrical Susceptibility and Dielectric Constant. Capacitor (parallel plate, spherical, cylindrical) filled with dielectric. Displacement vector **D**. Relations between **E**, **P** and **D**. Gauss' Law in dielectrics.

(8 Lectures)**Magnetic Field:**

Magnetic force between current elements and definition of Magnetic Field **B**. Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law and its application to (1) Solenoid and (2) Toroid. Properties of **B**: curl and divergence. Vector Potential. Magnetic Force on (1) on point charge (2) on current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic Field.

(11 Lectures)**Magnetic Properties of Matter:**

Magnetization vector (**M**). Magnetic Intensity (**H**). Magnetic Susceptibility and permeability. Relation between **B**, **H**, **M**. Ferromagnetism. B-H curve and hysteresis.

(4 Lectures)**Electromagnetic Induction:**

Recapitulation of Faraday's Law, Lenz's Law, Self Inductance and Mutual Inductance. Superposition Theorem. Reciprocity Theorem. Energy stored in a Magnetic Field. Introduction to Maxwell's Equations. Charge Conservation and Displacement current.

(6 Lectures)**Electrical Circuits:**

AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit.

(5 Lectures)**Ballistic Galvanometer:**

Torque on a current Loop. Ballistic Galvanometer: Current and Charge Sensitivity. Electromagnetic damping. Logarithmic damping. CDR.

(4 Lectures)

Reference Books:

- Electricity, Tayal D. C.
- Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
- Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
- Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
- Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education
- Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.
- Electricity and Magnetism, J.H.Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press.
- Electricity and Magnetism, Chattopadhyaya and Rakshit
- Electricity and Magnetism, Mahajan and Rangwala
- Electricity and Magnetism, K. K. Tewary.

PHYSICS PRACTICAL-C 3 LAB**60 Lectures**

1. Use a Multimeter for measuring
 - (a) Resistances, (b) AC and DC Voltages, (c) DC Current,
 - (d) Capacitances, and (e) Checking electrical fuses.
2. To study the characteristics of a series RC Circuit.
3. To determine an unknown Low Resistance using Potentiometer.
4. To compare capacitances using De'Sauty's bridge.
5. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
6. To verify the Thevenin and Norton theorems.
7. To verify the Superposition, and Maximum power transfer theorems.
9. To determine self inductance of a coil by Anderson's bridge.
10. To study response curve of a Series LCR circuit and determine its
 - (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and
 - (d) Band width.
11. To study the response curve of a parallel LCR circuit and determine its
 - (a) Anti resonant frequency and (b) Quality factor Q.
12. Measurement of charge and current sensitivity and CDR of Ballistic Galvanometer
13. Determine a high resistance by leakage method using Ballistic Galvanometer.

Reference Books

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

IV. CORE COURSE -C 4:

(Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) + 25 (Pr 3Hrs)=100**Pass Marks: Th (MSE +ESE) = 30 + Pr ESE =10*****Instruction to Question Setter for*****Mid Semester Examination (MSE):**

There will be **two** group of questions. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type** three questions of five marks each, out of which any two are to answer.

End Semester Examination (ESE):

There will be **two** group of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.

Note: There may be subdivisions in each question asked in Theory Examinations.

WAVES AND OPTICS**Theory: 60 Lectures**

Wave Motion: Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. Water Waves: Ripple and Gravity Waves.

(6 Lectures)

Velocity of Waves: Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction.

(6 Lectures)

Wave Optics: Electromagnetic nature of light. Definition and properties of wave front. Huygens Principle. Temporal and Spatial Coherence.

(5 Lectures)

Interference: Division of amplitude and wavefront. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism. 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). Newton's Rings: Measurement of wavelength and refractive index.

(12 Lectures)

Interferometer: Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer – theory and applications.

(6 Lectures)

Diffraction: Kirchhoff's Integral Theorem, Fresnel-Kirchhoff's Integral formula and its application to rectangular slit.

(6 Lectures)

Fraunhofer diffraction: Single slit. Circular aperture, Resolving Power of a telescope. Single slit. Double slit. Multiple slits. Diffraction grating. Resolving power of grating.

(10 Lectures)

Fresnel Diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire.

(9 Lectures)

Reference Books

- Waves and Acoustics, P. K. Chakraborty and Satyabrata Chowdhury.
- Introduction to Geometrical and Physical Optics, B. K. Mathur.
- Optics, Singh and Agarwal.
- Geometrical and Physical Optics, P. K. Chakraborty.
- Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
- Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
- Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
- Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
- The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
- The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.

PHYSICS PRACTICAL- C 4 LAB

60 Lectures

1. Familiarization with: Schuster's focusing; determination of angle of prism.
2. To determine refractive index of the Material of a prism using sodium source.
3. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
4. To determine wavelength of sodium light using Fresnel Biprism.
5. To determine wavelength of sodium light using Newton's Rings.
6. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.
7. To determine wavelength of (a) Na source and (b) spectral lines of Hg source using plane diffraction grating.
8. To determine dispersive power and resolving power of a plane diffraction grating.

Reference Books

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

SEMESTER III

5 Papers**Total 100 x 5 = 500 Marks****I. SKILL ENHANCEMENT COURSE SEC 1:**

(Credits: Theory-02)

Marks : 100 (ESE: 3Hrs) =100**Pass Marks Th ESE = 40***Instruction to Question Setter for**End Semester Examination (ESE):**There will be **objective type test** consisting of hundred questions of 1 mark each. Students are required to mark their answer on **OMR Sheet** provided by the University.***ELEMENTARY COMPUTER APPLICATION SOFTWARES:**

A Common Syllabus Prescribed by Ranchi University

Theory: 30 Lectures**Objective of the Course***The objective of the course is to generate qualified manpower in the area of Information Technology (IT) and Graphic designing which will enable such person to work seamlessly at any Offices, whether Govt. or Private or for future entrepreneurs in the field of IT.***A. INTRODUCTION TO COMPUTER SYSTEM****Basic Computer Concept**Computer Appreciation - Characteristics of Computers, Input, Output, Storage units, CPU, Computer System. **(1 Lecture)****Input and Output Devices**

Input Devices - Keyboard, Mouse, joystick, Scanner, web cam,

Output Devices- Soft copy devices, monitors, projectors, speakers, Hard copy devices, Printers – Dot matrix, inkjet, laser, Plotters. **(4 lectures)****Computer Memory and Processors**

Memory hierarchy, Processor registers, Cache memory, Primary memory- RAM, ROM, Secondary storage devices, Magnetic tapes, Floppy disks, hard disks, Optical Drives- CD-ROM, DVD-ROM, CD-R, CD-RW, USB Flash drive, Mass storage devices: USB thumb drive. Managing disk Partitions, File System. Basic Processor Architecture, Processor speed, Types of processor.

(5 lectures)**Numbers Systems and Logic Gates**

Decimal number system, Binary number system, Octal number system, Hexadecimal number system, Inter-conversion between the number systems. Basic Logic gates-AND, OR, NOT, Universal logic gates- NAND, NOR

(3 lectures)**Computer Software**

Computer Software- Relationship between Hardware and Software, System Software, Application Software, Compiler, Names of some high level languages, Free domain software.

(2 Lectures)

Internet & its uses

History of Internet, WWW and Web Browsers: Web Browsing software, Surfing the Internet, Chatting on Internet, Basic of electronic mail, Using Emails, Document handling, Network definition, Common terminologies: LAN, WAN, MAN, Node, Host, Workstation, Bandwidth, Network Components: Servers, Clients, Communication Media. Wireless network

(3 Lectures)**Operating system-Windows**

Operating system and basics of Windows, The User Interface, Using Mouse and Moving Icons on the screen, The My Computer Icon, The Recycle Bin, Status Bar, Start and Menu & Menu-selection, Running an Application, Windows Explorer Viewing of File, Folders and Directories, Creating and Renaming of files and folders, Opening and closing of different Windows, Windows Setting, Control Panels, Wall paper and Screen Savers, Setting the date and Sound, Concept of menu Using Help, Advanced Windows, Using right Button of the Mouse, Creating Short cuts, Basics of Window Setup, Notepad, Window Accessories

(2 Lectures)**B. MICROSOFT OFFICE 2007 AND LATEST VERSIONS****Word Processing**

Word processing concepts: saving, closing, Opening an existing document, Selecting text, Editing text, Finding and replacing text, printing documents, Creating and Printing Merged Documents, Character and Paragraph Formatting, Page Design and Layout. Editing and Checking. Correcting spellings. Handling Graphics, Creating Tables and Charts, Document Templates and Wizards, Mail merge and Macros.

(3 Lectures)**Microsoft Excel (Spreadsheet)**

Spreadsheet Concepts, Creating, Saving and Editing a Workbook, Inserting, Deleting Work Sheets, entering data in a cell / formula Copying and Moving from selected cells, handling operators in Formulae, Functions: Mathematical, Logical, statistical, text, financial, Date and Time functions, Using Function Wizard. Formatting a Worksheet: Formatting Cells changing data alignment, changing date, number, character or currency format, changing font, adding borders and colors, Printing worksheets, Charts and Graphs – Creating, Previewing, Modifying Charts. Integrating word processor, spread sheets, web pages. Pivot table, goal seek, Data filter and scenario manager

(4 Lectures)**Microsoft Power Point (Presentation Package)**

Creating, Opening and Saving Presentations, Creating the Look of Your Presentation, Working in Different Views, Working with Slides, Adding and Formatting Text, Formatting Paragraphs, Drawing and Working with Objects, Adding Clip Art and other pictures, Designing Slide Shows, Running and Controlling a Slide Show, Printing Presentations. Creating photo album, Rehearse timing and record narration. Master slides.

(3 Lectures)**Reference Books**

- Nishit Mathur, Fundamentals of Computer , Aph publishing corporation(2010)
- Misty E. Vermaat, .Microsoft word 2013 1st Edition (2013).
- Satish Jain, M.Geeta, MS- Office 2010 Training Guide, BPB publication (2010)
- Joan Preppernau, Microsoft PowerPoint 2016 step by step, Microsoft press(2015)
- Douglas E Corner, The Internet Book 4th Edition, prentice –Hall(2009)
- Faithe wempen, word 2016 in depth 1st edition, que publishing(2015)
- Steven welkler, Office 2016 for beginners, Create Space Independent publishing Plateform (2016)

SKILL ENHANCEMENT LAB- SEC 1 LAB

A. MS-WORD LAB ASSIGNMENT

1. Write down the following Paragraph OR any one provided by your teacher;

Without a doubt, the Internet is one of the most important inventions of modern times. The Internet is a global interconnected computer networks which allow each connected computer to share and exchange information with each other. The origins of the Internet can be traced to the creation of Advanced Research Projects Agency Network (ARPANET) as a network of computers under the auspices of the U.S. Department of Defense in 1969.

Apply following effects on The paragraph:

- i. Paragraph **font-size** and **font-type** must be 12 Verdana.
- ii. Paragraph **alignment** must be justified and double line spacing.
- iii. **Highlight** the “(ARPANET)” with green color.
- iv. Make the “Internet” keywords **Bold and Italic**.
- v. Insert any “**WordArt**” and a **symbol** to your document.
- vi. Insert a **clipart** to your document.
- vii. Add following lines to your document:
Internet, Intranet, Extranet, URL, WWW, Networking, Protocols, HTTP, TCP/IP

2. Create a Table of following fields:

Name, Surname, Age, Gender, Job and apply the following effects

- i. Insert 10 records
- ii. Font size should be 12
- iii. Title size should be 14
- iv. Font type should be Times new Roman
- v. Title color should be blue
- vi. Text color should be black
- vii. Table border should be 2

3. Write a letter on ‘Road Safety’ and send to ‘Multiple Recipients’ using mail merge.

4. Type the paragraph given below:

Today, the Internet is a public, cooperative and self-sustaining facility accessible to hundreds of millions of people worldwide. Physically, the Internet uses a portion of the total resources of the currently existing public telecommunication networks. Technically, what distinguishes the Internet is its use of a set of protocols called TCP/IP (for Transmission Control Protocol/Internet Protocol). Two recent adaptations of Internet technology, the intranet and the extranet, also make use of the TCP/IP protocol. Today, the Internet is a public, cooperative and self-sustaining facility accessible to hundreds of millions of people worldwide. Physically, the Internet uses a portion of the total resources of the currently existing public telecommunication networks. Technically, what distinguishes the Internet is its use of a set of protocols called TCP/IP (for Transmission Control Protocol/ Internet Protocol). Two recent adaptations of Internet technology, the intranet and the extranet, also make use of the TCP/IP protocol.

Apply the following:

- i. Change Internet into Internets at a time
- ii. Heilight TCP/IP in red color
- iii. Replace protocol into protocols
- iv. Find the word "Public"

B. MICROSOFT EXCEL LAB ASSIGNMENT

Basic Formatting and Spreadsheet Manipulation

1. Add rows and columns to an existing spreadsheet
2. Reformat data (center, comma and currency styles, bold, text color)
3. Work with a simple formula (product) and function (sum)

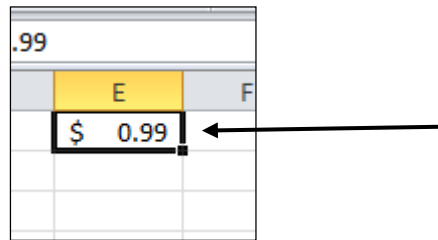
Assignment

1. Create a workbook as shown below.
2. To enter new rows or columns, simply click on the row or column header to select the whole row or column. Then right click with the mouse and choose insert.
3. Add the new row for S Spade with the data that's shown below (between the original rows 7 and 8).
4. Add a column for gender and the data as shown below (between the original columns A and B). Enter the appropriate gender for yourself in the last row.

A	B	C	D
Name	Male/Female	Genre	Number of Songs
J Smith	F	Blues	50
B Doe	M	Country	110
S Spade	F	Country	200
F Zappa	M	Blues	1400
F Zappa	M	Alternative	2300
J Smith	F	Alternative	150
S Spade	F	Blues	1000
B Doe	M	Blues	75
yourname	M	Blues	800

5. Center the data in columns B and C. Do this by selecting the whole column and click the center icon on the ribbon.
6. Bold the data in row 1, the column headings (ensure that the data all remains visible within the column boundaries).
7. Change the font color for row 1 to Blue.
8. Change the format of the data in column D to comma style (no decimal places showing). There is an icon on the home tab that sets it to comma style easily.
9. Add two new column labels to the right of the current columns; **Unit Price** and **Total Cost**. (They will be in columns E and F.) These two columns of data should be currency type so that the dollar sign is shown. There is an icon to quickly format the selected column as currency type.
10. All tunes are \$.99, so enter that value for all rows in Column E. You can copy quickly by using the **Auto Fill** handle and drag that amount down. When you over your mouse over the tiny square in

the bottom right hand corner of the active cell, your mouse shape will become a skinny plus sign, and you can click and drag that cell to make a copy.



11. Calculate Total Cost (column F) as *column D times Column E*. You will type in a formula like this into cell F2: **=D2*E2** (Be sure to begin the formula with an equal sign)
12. Use the AutoFill (skinny plus sign) again to copy the formula down column F; down to F10. Double check the picture below to make sure yours has the correct values
13. Add a border to all of the cells (A1-f10) using the Borders tool in the Fonts group on the Home Tab.
14. Change the page layout to landscape. Do this by clicking the Page Layout tab on the ribbon and then to Orientation to Landscape.
15. Save the file.
16. Click in cell F11 and Use the sum function or the shortcut icon that looks like Σ to get the total of the Total Cost column.
17. Ensure that the data is all visible within the column boundaries. Make the columns wider if needed.
18. Save the workbook. Your final spreadsheet should look like the following when printed.

Name	Male/Female	Genre	Number of Songs	Unit Price	Total Cost
J Smith	F	Blues	50	\$ 0.99	\$ 49.50
B Doe	M	Country	110	\$ 0.99	\$ 108.90
S Spade	F	Country	200	\$ 0.99	\$ 198.00
F Zappa	M	Blues	1,400	\$ 0.99	\$ 1,386.00
F Zappa	M	Alternative	2,300	\$ 0.99	\$ 2,277.00
S Spade	F	Blues	1,000	\$ 0.99	\$ 990.00
J Smith	F	Alternative	150	\$ 0.99	\$ 148.50
B Doe	M	Blues	75	\$ 0.99	\$ 74.25
yourname	M	Blues	800	\$ 0.99	\$ 792.00

\$ 6,024.15

Create a sample table given below in Excel

- Using formula find Total
- Find the maximum value using MAX function from the **Units** column
- Find minimum value from **Total** column

Order Date	Region	Rep	Item	Units	Unit Cost	Total
1/6/2016	East	Jones	Pencil	95	1.99	189.05
1/23/2016	Central	Kivell	Binder	50	19.99	999.50
2/9/2016	Central	Jardine	Pencil	36	4.99	179.64
2/26/2016	Central	Gill	Pen	27	19.99	539.73
3/15/2016	West	Sorvino	Pencil	56	2.99	167.44
4/1/2016	East	Jones	Binder	60	4.99	299.40
4/18/2016	Central	Andrews	Pencil	75	1.99	149.25
5/5/2016	Central	Jardine	Pencil	90	4.99	449.10
5/22/2016	West	Thompson	Pencil	32	1.99	63.68
6/8/2016	East	Jones	Binder	60	8.99	539.40
6/25/2016	Central	Morgan	Pencil	90	4.99	449.10
7/12/2016	East	Howard	Binder	29	1.99	57.71
7/29/2016	East	Parent	Binder	81	19.99	1,619.19
8/15/2016	East	Jones	Pencil	35	4.99	174.65
9/1/2016	Central	Smith	Desk	2	125.00	250.00
9/18/2016	East	Jones	Pen Set	16	15.99	255.84
10/5/2016	Central	Morgan	Binder	28	8.99	251.72
10/22/2016	East	Jones	Pen	64	8.99	575.36
11/8/2016	East	Parent	Pen	15	19.99	299.85
11/25/2016	Central	Kivell	Pen Set	96	4.99	479.04
12/12/2016	Central	Smith	Pencil	67	1.29	86.43
12/29/2016	East	Parent	Pen Set	74	15.99	1,183.26

C. MS-POWERPOINT LAB ASSIGNMENT

Activity 1 : Using Text & Background/Themes

- i. Create one new slide and insert any text.
- ii. To make your slide more attractive, use the themes or background.
- iii. Make sure it apply for every slide not only one slide.

Activity 2 : Apply Custom Animation On Text

- i. Use the custom animation to add effects on your text. Set the text move after you click the mouse.
- ii. If you have more than one text, add effects for each of text.

Activity 3 : Insert Image & WordArt

- i. Insert one new blank slide.
- ii. Choose one pictures or clip art from any source and insert in your new slide.
- iii. Using the WordArt, make a note or title on your picture.
- iv. Use the custom animation again to add effects on your picture and WordArt.

Activity 4 : Insert Text Box

- i. Insert one new blank slide.
- ii. Use the text box to insert one paragraph of text and adjust your text.

Activity 5 : Insert Smart Art

- i. Insert one new blank slide.
- ii. Insert the Smart Art and put your text on the Smart Art.

Activity 6 : Insert Audio

- i. Back to your first slide and insert one audio on that slide. The audio must play automatically when you show your slide.
- ii. Make sure the speaker also not appear when you show your slide. (the icon).
- iii. The audio must play when you show alls your slide, not only one slide.

Activity 7 : inserting Video

- i. Insert one new slide and insert one short video

Activity 8 : Save File

- i. Save your file

Activity 9 : Create Photo Album & Hyperlink

- i. Insert one new slide and put a text ex: “My Photo Album”
- ii. Create one photo album and adjust your text and your photos
- iii. Save your photo album with a new file
- iv. Make a hyperlink to your photo using the text “My Photo Album”

Reference Books:

- Faithe wempen, word 2016 in depth 1st edition, que publishing(2015)
- steven welkler, Office 2016 for bignners, Create Space Independent publishing plateform(2016)
- Elaine Marmel, office 2016 simplified, 1st Edition, John wiley and sons Inc(2016)
- Patrice-Anne Rutledge, Easy office 2016 1st edition, Que publishing(2016)

II. GENERIC ELECTIVE (GE 3)

(Credits: 06)

All Four Papers (One paper to be studied in each semester) of any One Subject to be opted other than the Honours Subject. Refer Content from the Syllabus of Opted Generic Elective Subject.

III. CORE COURSE -C 5:

(Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) + 25 (Pr 3Hrs)=100	Pass Marks: Th (MSE +ESE) = 30 + Pr ESE =10
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Instruction to Question Setter for***Mid Semester Examination (MSE):***

There will be two group of questions. Group A is compulsory and will contain five questions of very short answer type consisting of 1 mark each. Group B will contain descriptive type three questions of five marks each, out of which any two are to answer.

End Semester Examination (ESE):

There will be two group of questions. Group A is compulsory and will contain two questions. Question No.1 will be very short answer type consisting of ten questions of 1 mark each. Question No.2 will be short answer type of 5 marks. Group B will contain descriptive type five questions of fifteen marks each, out of which any three are to answer.

Note: *There may be subdivisions in each question asked in Theory Examinations.*

MATHEMATICAL PHYSICS-II**Theory: 60 Lectures**

The emphasis of the course is on applications in solving problems of interest to Physicists. Students are to be examined on the basis of problems, seen and unseen.

Fourier Series:

Periodic functions. Orthogonality of sine and cosine functions, Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourier series. Expansion of functions with arbitrary period. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions. Application. Analysis of saw-tooth and square wave. Summing of Infinite Series. Term-by-Term differentiation and integration of Fourier Series.

(14 Lectures)**Frobenius Method and Special Functions:**

Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations. Legendre, Bessel, Hermite and Laguerre Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Generating Function, Orthogonality. Simple recurrence relations. Expansion of function in a series of Legendre Polynomials. Bessel Functions of the First Kind: Generating Function, simple recurrence relations. Zeros of Bessel Functions and Orthogonality.

(24 Lectures)**Some Special Integrals:**

Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral).

(4 Lectures)**Theory of Errors:**

Systematic and Random Errors. Propagation of Errors. Normal Law of Errors. Standard and Probable Error.

(4 Lectures)**Partial Differential Equations:**

Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry. Wave equation and its solution for vibrational modes of a stretched string.

(14 Lectures)**Reference Books:**

- Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
 - Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
 - Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
 - Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
 - Partial Differential Equations for Scientists & Engineers, S.J. Farlow, 1993, Dover Pub.
 - Mathematical methods for Scientists & Engineers, D.A. McQuarrie, 2003, Viva Books
 - Mathematical Physics, B. D. Gupta.
 - Mathematical Physics, B. S. Rajput.
 - Mathematical Physics, H. K. Dass.
 - Mathematical methods in Physics, E. Butkov.
 - Mathematical methods in Physics, Potter and Goldberg.
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PHYSICS PRACTICAL-C 5 LAB**60 Lectures**

The aim of this Lab is to use the computational methods to solve physical problems. Course will consist of lectures (both theory and practical) in the Lab. Evaluation done not on the programming but on the basis of formulating the problem

Topics	Description with Applications
Introduction to Numerical computation software Scilab	Introduction to Scilab, Advantages and disadvantages, Scilab environment, Command window, Figure window, Edit window, Variables and arrays, Initialising variables in Scilab, Multidimensional arrays, Subarray, Special values, Displaying output data, data file, Scalar and array operations, Hierarchy of operations, Built in Scilab functions, Introduction to plotting, 2D and 3D plotting, Branching Statements and program design, Relational & logical operators, the while loop, for loop, details of loop operations, break & continue statements, nested loops, logical arrays and vectorization. User defined functions, Introduction to Scilab functions, variable passing in Scilab, optional arguments, preserving data between calls to a function, Complex and Character data, string function, Multidimensional arrays an introduction to Scilab file processing, file opening and closing, Binary I/o functions, comparing binary and formatted functions, Numerical methods and developing the skills of writing a program.
Curve fitting, Least square fit, Goodness of fit, standard deviation	Ohms law to calculate R, Hooke's law to calculate spring constant
Solution of Linear system of equations by Gauss elimination method and Gauss Seidal method. Diagonalization of matrices, Inverse of a matrix, Eigen vectors, eigen values problems	Solution of mesh equations of electric circuits (3 meshes) Solution of coupled spring mass systems (3 masses)
Solution of ODE First order Differential equation Euler, modified Euler and Runge-Kutta second order methods Second	First order differential equation, Radioactive decay, Current in RC, LC circuits with DC source, Newton's law of cooling, Classical equations of motion, Second order Differential Equation, Harmonic oscillator (no friction), Damped Harmonic oscillator, Over damped, Critical damped, Oscillatory, Forced Harmonic oscillator, Transient and, Steady state solution Apply above to LCR circuits also.

order differential equation	
Fixed difference method	

Reference Books:

- Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J.Bence, 3rd ed., 2006, Cambridge University Press
- Complex Variables, A.S. Fokas & M.J. Ablowitz, 8th Ed., 2011, Cambridge Univ. Press
- First course in complex analysis with applications, D.G. Zill and P.D. Shanahan, 1940, Jones & Bartlett
- Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A.V. Wouwer, P. Saucez, C.V. Fernández. 2014 Springer
- Scilab by example: M. Affouf 2012, ISBN: 978-1479203444
- Scilab (A free software to Matlab): H.Ramchandran, A.S.Nair. 2011 S.Chand & Company
- Scilab Image Processing: Lambert M. Surhone. 2010 Betascript Publishing

IV. CORE COURSE -C 6:

(Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) + 25 (Pr 3Hrs)=100**Pass Marks: Th (MSE +ESE) = 30 + Pr ESE =10*****Instruction to Question Setter for******Mid Semester Examination (MSE):***

There will be two group of questions. Group A is compulsory and will contain five questions of very short answer type consisting of 1 mark each. Group B will contain descriptive type three questions of five marks each, out of which any two are to answer.

End Semester Examination (ESE):

There will be two group of questions. Group A is compulsory and will contain two questions. Question No.1 will be very short answer type consisting of ten questions of 1 mark each. Question No.2 will be short answer type of 5 marks. Group B will contain descriptive type five questions of fifteen marks each, out of which any three are to answer.

Note: *There may be subdivisions in each question asked in Theory Examinations.*

THERMAL PHYSICS**Theory: 60 Lectures***(Include related problems for each topic)***INTRODUCTION TO THERMODYNAMICS****Zeroth and First Law of Thermodynamics:**

Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes, Applications of First Law: General Relation between C_P and C_V , Work Done during Isothermal and Adiabatic Processes. **(8 Lectures)**

Second Law of Thermodynamics: Reversible and Irreversible process with examples. Heat Engines. Carnot's Cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, 2nd Law of

Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Carnot's Theorem. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale. **(10 Lectures)**

Entropy: Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Principle of Increase of Entropy. Temperature-Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics (Nearst's Heat Theorem). Unattainability of Absolute Zero. **(7 Lectures)**

Thermodynamic Potentials: Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Their Definitions, Properties and Applications. Surface Films. Cooling due to adiabatic demagnetization, First and second order Phase Transitions with examples. **(7 Lectures)**

Maxwell's Thermodynamic Relations: Derivations and applications of Maxwell's Relations, (1) Clausius Clapeyron equation, (2) Value of C_p-C_v , (3) TdS Equations, (4) Joule-Kelvin coefficient for Ideal and Van der Waal Gases. **(7 Lectures)**

KINETIC THEORY OF GASES

Distribution of Velocities: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas. Stern's Experiment. Mean, RMS and Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy (No proof required). Specific heats of Gases. **(7 Lectures)**

Molecular Collisions: Mean Free Path. Collision Probability. Estimates of Mean Free Path. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. **(4 Lectures)**

Real Gases: Behavior of Real Gases: Deviations from the Ideal Gas Equation. The Virial Equation. Critical Constants. Boyle Temperature. Van der Waal's Equation of State for Real Gases. Values of Critical Constants. Law of Corresponding States. Comparison with Experimental Curves. P-V Diagrams. Joule's Experiment. Free Adiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment. Joule-Thomson Effect for Real and Van der Waal Gases. Temperature of Inversion. Joule-Thomson Cooling. **(10 Lectures)**

Reference Books:

- Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
 - A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, 1958, Indian Press
 - Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill
 - Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
 - Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa.
 - Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford University Press
 - Heat and Thermodynamics, A. B. Gupta and H. P. Roy.
 - Heat and Thermodynamics, P. K. Chakraborty.
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PHYSICS PRACTICAL- C 6 LAB**60 Lectures**

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.
3. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee's disc method.
4. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).
5. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.
6. To calibrate a thermocouple to measure temperature in a specified Range using (1) Null Method and to determine Neutral Temperature.

Reference Books

- Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
 - A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
 - Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
 - A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.
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V. CORE COURSE -C 7:

(Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) + 25 (Pr 3Hrs)=100**Pass Marks: Th (MSE +ESE) = 30 + Pr ESE =10*****Instruction to Question Setter for******Mid Semester Examination (MSE):***

There will be two group of questions. Group A is compulsory and will contain five questions of very short answer type consisting of 1 mark each. Group B will contain descriptive type three questions of five marks each, out of which any two are to answer.

End Semester Examination (ESE):

There will be two group of questions. Group A is compulsory and will contain two questions. Question No.1 will be very short answer type consisting of ten questions of 1 mark each. Question No.2 will be short answer type of 5 marks. Group B will contain descriptive type five questions of fifteen marks each, out of which any three are to answer.

Note: There may be subdivisions in each question asked in Theory Examinations.

DIGITAL SYSTEMS AND APPLICATIONS**Theory: 60 Lectures**

Digital Circuits: Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion. BCD, Octal and Hexadecimal numbers. AND, OR and NOT Gates. NAND and NOR Gates as Universal Gates. XOR and XNOR Gates.

(10 Lectures)

Boolean algebra: De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Fundamental Products. Idea of Minterms and Maxterms. Conversion of a Truth table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map.

(10 Lectures)

Data processing circuits: Basic idea of Multiplexers, De-multiplexers, Decoders, Encoders.

(6 Lectures)

Arithmetic Circuits: Binary Addition. Binary Subtraction using 2's Complement. Half and Full Adders, 4-bit binary Adder.

(6 Lectures)

Sequential Circuits: SR, D, and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip-Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop. M/S JK Flip-Flop.

(10 Lectures)

Timers: IC 555: block diagram and applications: Astable multivibrator and Monostable multivibrator.

(6 Lectures)

Shift registers: Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers (only up to 4 bits).

(6 Lectures)

Counters (4 bits): Ring Counter. Asynchronous counters, Decade Counter. Synchronous Counter.

(6 Lectures)

Reference Books:

- Digital Principles and Applications, A.P. Malvino, D.P. Leach and Saha, 7th Ed., 2011, Tata McGraw
- Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd.
- Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
- Digital Systems: Principles & Applications, R.J. Tocci, N.S. Widmer, 2001, PHI Learning
- Logic circuit design, Shimon P. Vingron, 2012, Springer.
- Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
- Microprocessor Architecture Programming & applications with 8085, 2002, R.S. Goankar, Prentice Hall.
- Digital Electronics, Floyd.
- Digital Computer Electronics, Malvino
- Digital Logic and Computer Design, M. Morris Mano.

PHYSICS PRACTICAL-C 7 LAB**60 Lectures**

1. To measure
 - (a) Voltage, and
 - (b) Time period of a periodic waveform using CRO.
2. To test a Diode and Transistor using a Multimeter.
3. To design a switch (NOT gate) using a transistor.
4. To verify and design AND, OR, NOT and XOR gates using NAND gates.
5. To design a combinational logic system for a specified Truth Table.
6. To convert a Boolean expression into logic circuit and design it using logic gate ICs.
7. To minimize a given logic circuit.
8. Half Adder, Full Adder and 4-bit binary Adder.
9. Half Adder and Full Adder Truth table verification using I.C.
10. To build Flip-Flop (RS, Clocked RS, D-type and JK) circuits using NAND gates.
11. To design an astable multivibrator of given specifications using 555 Timer.
12. To design a monostable multivibrator of given specifications using 555 Timer.

Reference Books:

- Modern Digital Electronics, R.P. Jain, 4th Edition, 2010, Tata McGraw Hill.
 - Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.
 - Microprocessor Architecture Programming and applications with 8085, R.S. Goankar, 2002, Prentice Hall.
 - Microprocessor 8085: Architecture, Programming and interfacing, A. Wadhwa, 2010, PHI Learning.
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SEMESTER IV

5 Papers**Total 100 x 5 = 500 Marks****I. SKILL ENHANCEMENT COURSE SEC 2:**

(Credits: Theory-02)

Marks : 100 (ESE 3Hrs) =100**Pass Marks Th ESE = 40*****Instruction to Question Setter for******End Semester Examination (ESE):***

There will be two group of questions. Group A is compulsory and will contain three questions. Question No.1 will be very short answer type consisting of ten questions of 1 mark each. Question No.2 & 3 will be short answer type of 5 marks. Group B will contain descriptive type six questions of 20 marks each, out of which any four are to answer.

Note: There may be subdivisions in each question asked in Theory Examinations.

ELECTRICAL CIRCUIT NETWORK SKILLS**Theory: 30 Lectures**

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

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.

(4 Lectures)**Understanding Electrical Circuits:**

Main electric circuit elements and their combination. Rules to analyze DC sourced electrical circuits. Current and voltage drop across the DC circuit elements. Single-phase and three-phase alternating current sources. Rules to analyze AC sourced electrical circuits. Real, imaginary and complex power components of AC source. Power factor. Saving energy and money.

(6 Lectures)**Generators and Transformers:**

DC Power sources. AC/DC generators. Inductance, capacitance, and impedance. Operation of transformers.

(4 Lectures)**Electric Motors:**

Single-phase, three-phase & DC motors. Basic design. Interfacing DC or AC sources to control heaters & motors. Speed & power of ac motor.

(6 Lectures)**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)

(6 Lectures)

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.

(4 Lectures)

Laboratory Exercises:

1. Use of multimeter, voltmeter and ammeter
2. To observe current and voltage drop across the DC circuit elements.
3. To track the connections of elements and identify current flow and voltage drop.
4. To observe the working of transformer under no load and full load condition
5. Use of diode as half wave, full wave and bridge rectifier
6. To observe the response of inductor and capacitor with DC or AC sources
7. To understand the importance of interfacing DC or AC sources to relay protection device
8. To prepare an extension board with more than one input terminal (3 pin socket) and check its working

Reference Books:

- A text book in Electrical Technology - B L Theraja - S Chand & Co.
- A text book of Electrical Technology - A K Theraja
- Performance and design of AC machines - M G Say ELBS Edn.

II. GENERIC ELECTIVE (GE 4)

(Credits: 06)

All Four Papers (One paper to be studied in each semester) of any One Subject to be opted other than the Honours Subject. Refer Content from the Syllabus of Opted Generic Elective Subject.

III. CORE COURSE -C 8:

(Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) + 25 (Pr 3Hrs)=100	Pass Marks: Th (MSE +ESE) = 30 + Pr ESE =10
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Instruction to Question Setter for***Mid Semester Examination (MSE):***

There will be two group of questions. Group A is compulsory and will contain five questions of very short answer type consisting of 1 mark each. Group B will contain descriptive type three questions of five marks each, out of which any two are to answer.

End Semester Examination (ESE):

There will be two group of questions. Group A is compulsory and will contain two questions. Question No.1 will be very short answer type consisting of ten questions of 1 mark each. Question No.2 will be short answer type of 5 marks. Group B will contain descriptive type five questions of fifteen marks each, out of which any three are to answer.

Note: *There may be subdivisions in each question asked in Theory Examinations.*

MATHEMATICAL PHYSICS-III**Theory: 60 Lectures**

The emphasis of the course is on applications in solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen.

Complex Analysis:

Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Singular functions: poles, order of singularity, Integration of a function of a complex variable. Cauchy's Inequality. Cauchy's Integral formula. Simply and multiply connected region. Laurent and Taylor's expansion. Residues and Residue Theorem. Application in solving Definite Integrals.

(30 Lectures)**Integrals Transforms:**

Fourier Transforms: Fourier Integral theorem. Fourier Transform. Examples. Fourier transform of trigonometric, Gaussian, finite wave train & other functions. Representation of Dirac delta function as a Fourier Integral. Fourier transform of derivatives, Inverse Fourier transform, Properties of Fourier transforms (translation, change of scale, complex conjugation, etc.). Three dimensional Fourier transforms with examples. Application of Fourier Transforms to differential equations: One dimensional Wave and Diffusion/Heat Flow Equations.

(15 Lectures)**Laplace Transforms:**

Laplace Transform (LT) of Elementary functions. Properties of LTs: Change of Scale Theorem, Shifting Theorem. LTs of Derivatives and Integrals of Functions, Derivatives and Integrals of LTs. LT of Unit Step function, Convolution Theorem. Inverse LT. Application of Laplace Transforms to Differential Equations: Damped Harmonic Oscillator, Simple Electrical Circuits.

(15 Lectures)**Reference Books:**

- Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press
- Mathematics for Physicists, P. Dennery and A.Krzywicki, 1967, Dover Publications
- Complex Variables, A.S.Fokas & M.J.Ablowitz, 8th Ed., 2011, Cambridge Univ. Press
- Complex Variables and Applications, J.W. Brown & R.V. Churchill, 7th Ed. 2003, Tata McGraw-Hill
- First course in complex analysis with applications, D.G. Zill and P.D. Shanahan, 1940, Jones & Bartlett.
- Mathematical Physics, B. D. Gupta.
- Mathematical Physics, B. S. Rajput.
- Mathematical Physics, H. K. Dass.
- Mathematical methods in Physics, E. Butkov.
- Mathematical methods in Physics, Potter and Goldberg.

PHYSICS PRACTICAL-C 8 LAB**60 Lectures***Scilab based simulations experiments based on Mathematical Physics problems like*

1. Solve differential equations:

$$\frac{dy}{dx} = e^{-x} \quad \text{with } y = 0 \text{ for } x = 0$$

$$\frac{dy}{dx} + e^{-x}y = x^2$$

$$\frac{d^2y}{dt^2} + 2\frac{dy}{dt} = -y$$

$$\frac{d^2y}{dt^2} + e^{-t}\frac{dy}{dt} = -y$$

2. Dirac Delta Function:

Evaluate $\frac{1}{\sqrt{2\pi\sigma^2}} \int e^{-\frac{(x-2)^2}{2\sigma^2}} (x+3)dx$, for $\sigma = 1, 0.1, 0.01$ and show it tends to 5.

3. Fourier Series:

Program to sum $\sum_{n=1}^{\infty} (0.2)^n$

Evaluate the Fourier coefficients of a given periodic function (square wave).

4. Frobenius method and Special functions:

$$\int_{-1}^{+1} P_n(\mu)P_m(\mu)d\mu = \delta_{n,m}$$

Plot $P_n(x)$, $j_v(x)$

Show recursion relation.

5. Calculation of error for each data point of observations recorded in experiments done in previous semesters (choose any two).

6. Calculation of least square fitting manually without giving weightage to error. Confirmation of least square fitting of data through computer program.

7. Evaluation of trigonometric functions e.g. $\sin \theta$, Given Bessel's function at N points find its value at an intermediate point. Complex analysis: Integrate $1/(x^2+2)$ numerically and check with computer integration.8. Integral transform: FFT of e^{-x^2} .**Reference Books:**

- Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press
- Mathematics for Physicists, P. Dennery and A. Krzywicki, 1967, Dover Publications
- Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández. 2014 Springer ISBN: 978-3319067896
- Scilab by example: M. Affouf, 2012. ISBN: 978-1479203444
- Scilab (A free software to Matlab): H.Ramchandran, A.S.Nair. 2011 S.Chand & Company
- Scilab Image Processing: Lambert M. Surhone. 2010 Betascript Publishing

IV. CORE COURSE -C 9:

(Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) + 25 (Pr 3Hrs)=100**Pass Marks: Th (MSE +ESE) = 30 + Pr ESE =10*****Instruction to Question Setter for*****Mid Semester Examination (MSE):**

There will be **two** group of questions. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type** three questions of five marks each, out of which any two are to answer.

End Semester Examination (ESE):

There will be **two** group of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.

Note: There may be subdivisions in each question asked in Theory Examinations.

ELEMENTS OF MODERN PHYSICS**Theory: 60 Lectures****Quantum theory of Light:**

Wave-particle duality, Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and relation between them. Two-Slit experiment with electrons. Probability. Wave amplitude and wave functions.

(15 Lectures)**Quantum Uncertainty:**

Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables): Derivation from Wave Packets impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle.

(6 Lectures)**Matter waves and wave amplitude;**

Schrodinger equation for non-relativistic particles; Physical quantities as operators, Position, Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities and normalization; Probability and probability current densities in one dimension.

(10 Lectures)**One dimensional infinitely rigid box-**

Energy eigenvalues and eigenfunctions, normalization; Quantum mechanical scattering and tunneling in one dimension-across a step potential & rectangular potential barrier.

(10 Lectures)**Radioactivity:**

Stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay; Beta decay-energy released, spectrum and Pauli's prediction of neutrino; Gamma ray emission, energy-momentum conservation: electron-positron pair creation by gamma photons in the vicinity of a nucleus.

(10 Lectures)

Fission and fusion-

Mass deficit, Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions driving stellar energy (brief qualitative discussions).

(3 Lectures)**Lasers:**

Einstein's A and B coefficients. Metastable states. Spontaneous and Stimulated emissions. Optical Pumping and Population Inversion. Three-Level and Four-Level Lasers. Ruby Laser and He-Ne Laser.

(6 Lectures)**Reference Books:**

- Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
- Introduction to Quantum mechanics, Nikhil Ranjan Roy, 2016, Vikash Publishing House Pvt. Ltd.
- Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
- Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
- Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 2010, Cengage Learning.
- Quantum Mechanics: Theory & Applications, A.K.Ghatak & S.Lokanathan, 2004, Macmillan

Additional Books for Reference

- Modern Physics, J.R. Taylor, C.D. Zafiratos, M.A. Dubson, 2004, PHI Learning.
- Theory and Problems of Modern Physics, Schaum's outline, R. Gautreau and W. Savin, 2nd Edn, Tata McGraw-Hill Publishing Co. Ltd.
- Quantum Physics, Berkeley Physics, Vol.4. E.H.Wichman, 1971, Tata McGraw-Hill Co.
- Basic ideas and concepts in Nuclear Physics, K.Heyde, 3rd Edn., Institute of Physics Pub.
- Six Ideas that Shaped Physics: Particle Behave like Waves, T.A.Moore, 2003, McGraw Hill

PHYSICS PRACTICAL-C 9 LAB**60 Lectures**

1. Measurement of Planck's constant using black body radiation and photo-detector
2. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light.
3. To determine work function of material of filament of directly heated vacuum diode.
4. To determine the Planck's constant using LEDs of at least 4 different colours.
5. To determine the value of e/m by using a Bar magnet.
6. To show the tunneling effect in tunnel diode using I-V characteristics.
7. To determine the wavelength of laser source using diffraction of single slit.
8. To determine the wavelength of laser source using diffraction of double slits.
9. To determine (1) wavelength and (2) angular spread of He-Ne laser using plane diffraction grating

Reference Books

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal

V. CORE COURSE -C 10:

(Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) + 25 (Pr 3Hrs)=100**Pass Marks: Th (MSE +ESE) = 30 + Pr ESE =10*****Instruction to Question Setter for*****Mid Semester Examination (MSE):**

There will be **two** group of questions. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type** three questions of five marks each, out of which any two are to answer.

End Semester Examination (ESE):

There will be **two** group of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.

Note: There may be subdivisions in each question asked in Theory Examinations.

ANALOG SYSTEMS AND APPLICATIONS**Theory: 60 Lectures****Semiconductor Diodes:**

P and N type semiconductors. Energy Level Diagram. Conductivity and Mobility, Barrier Formation in PN Junction Diode. Static and Dynamic Resistance. Current Flow Mechanism in Forward and Reverse Biased Diode. Drift Velocity. Derivation for Barrier Potential, Barrier Width and Current for Step Junction.

(10 Lectures)**Two-terminal Devices and their Applications:**

(1) Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, (2) Zener Diode and Voltage Regulation. Principle and structure of (1) LEDs, (2) Photodiode, (3) Solar Cell.

(6 Lectures)**Bipolar Junction transistors:**

n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Current gains α and β Relations between α and β . Load Line analysis of Transistors. DC Load line and Q-point. Physical Mechanism of Current Flow. Active, Cut off and Saturation Regions.

(6 Lectures)**Amplifiers:**

Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias. Transistor as 2-port Network. h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains. Classification of Class A, B & C Amplifiers.

(10 Lectures)

Coupled Amplifier: RC-coupled amplifier and its frequency response.

(4 Lectures)**Feedback in Amplifiers:**

Effects of Positive and Negative Feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise.

(5 Lectures)

Sinusoidal Oscillators:

Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency. Hartley & Colpitts oscillators.

(6 Lectures)**Operational Amplifiers (Black Box approach):**

Characteristics of an Ideal and Practical Op-Amp. (IC 741) Open-loop and Closed-loop Gain. Frequency Response. CMRR. Slew Rate and concept of Virtual ground.

(4 Lectures)**Applications of Op-Amps:**

- (1) Inverting and non-inverting amplifiers, (2) Adder,
 (3) Subtractor, (4) Differentiator,
 (5) Integrator, (6) Log amplifier

(9 Lectures)**Reference Books:**

- Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
- Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
- Solid State Electronic Devices, B.G.Streetman & S.K.Banerjee, 6th Edn.,2009, PHI Learning Electronic Devices & circuits, S.Salivahanan & N.S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill
- OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall
- Electronic circuits: Handbook of design & applications, U.Tietze, C.Schenk,2008, Springer
- Semiconductor Devices: Physics and Technology, S.M. Sze, 2nd Ed., 2002, Wiley India
- Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India
- A first course in Electronics, Khan and Dey, PHI
- Basic Electronics, Arun Kumar
- Microelectronics, Millman and Grabel

PHYSICS PRACTICAL-C 10 LAB**60 Lectures**

1. To study V-I characteristics of PN junction diode, and Light emitting diode.
2. To study the V-I characteristics of a Zener diode and its use as voltage regulator.
3. Study of V-I & power curves of solar cells, and find maximum power point & efficiency.
4. To study the characteristics of a Bipolar Junction Transistor in CE configuration.
5. To design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.
6. To study the frequency response of voltage gain of a RC-coupled transistor amplifier.
7. To design a phase shift oscillator of given specifications using BJT.
8. To study the Colpitt's oscillator.
9. To study the analog to digital convertor (ADC) IC.
10. To design an inverting amplifier using Op-amp (741,351) for dc voltage of given gain
11. To design inverting amplifier using Op-amp (741,351) and study its frequency response
12. To design non-inverting amplifier using Op-amp (741,351) & study its frequency response
13. To add two dc voltages using Op-amp in inverting and non-inverting mode
14. To investigate the use of an op-amp as an Integrator.
15. To investigate the use of an op-amp as a Differentiator.

Reference Books:

- Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.
- OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall.
- Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.
- Electronic Devices & circuit Theory, R.L. Boylestad & L.D. Nashelsky, 2009, Pearson

SEMESTER V

4 Papers**Total 100 x 4 = 400 Marks****I. PHYSICS SPECIFIC (DSE 1):**

(Credits: Theory-05, Tutorials-01)

Marks : 25 (MSE: 1Hr) + 75 (ESE: 3Hrs) =100**Pass Marks: Th (MSE +ESE) = 40*****Instruction to Question Setter for******Mid Semester Examination (MSE):***

There will be two group of questions. Group A is compulsory and will contain five questions of very short answer type consisting of 1 mark each. Group B will contain descriptive type six questions of five marks each, out of which any four are to answer.

End Semester Examination (ESE):

There will be two group of questions. Group A is compulsory and will contain two questions. Question No.1 will be very short answer type consisting of ten questions of 1 mark each. Question No.2 will be short answer type of 5 marks. Group B will contain descriptive type six questions of fifteen marks each, out of which any four are to answer.

Note: There may be subdivisions in each question asked in Theory Examinations.

NUCLEAR AND PARTICLE PHYSICS**Theory: 75 Lectures****General Properties of Nuclei:**

Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density (matter density), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excited states.

(10 Lectures)**Nuclear Models:**

Liquid drop model approach, semi empirical mass formula and significance of its various terms, condition of nuclear stability, Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi gas), evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, concept of nuclear force.

(12 Lectures)**Radioactivity decay:**

(a) Alpha decay: basics of α -decay processes, theory of α - emission, Gamow factor, Geiger Nuttall law, α -decay spectroscopy. (b) β -decay: energy kinematics for β -decay, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays emission & kinematics, internal conversion.

(12 Lectures)**Nuclear Reactions:**

Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct Reaction, resonance reaction, Coulomb scattering (Rutherford scattering).

(10 Lectures)

Interaction of Nuclear Radiation with matter:

Energy loss due to ionization (Bethe- Block formula), energy loss of electrons, Cerenkov radiation. Gamma ray interaction through matter, photoelectric effect, Compton scattering, pair production, neutron interaction with matter.

(7 Lectures)

Detector for Nuclear Radiations:

Gas detectors: estimation of electric field, mobility of particle, for ionization chamber and GM Counter. Basic principle of Scintillation Detectors and construction of photo-multiplier tube (PMT). Semiconductor Detectors (Si and Ge) for charge particle and photon detection (concept of charge carrier and mobility), neutron detector.

(10 Lectures)

Particle Physics:

Particle interactions; basic features, types of particles and its families. Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Concept of quark model.

(14 Lectures)

Reference Books:

- Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
 - Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998).
 - Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004).
 - Introduction to High Energy Physics, D.H. Perkins, Cambridge Univ. Press
 - Introduction to Elementary Particles, D. Griffith, John Wiley & Sons
 - Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, New Delhi
 - Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (IOP- Institute of Physics Publishing, 2004).
 - Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
 - Physics and Engineering of Radiation Detection, Syed Naeem Ahmed (Academic Press, Elsevier, 2007).
 - Theoretical Nuclear Physics, J.M. Blatt & V.F. Weisskopf (Dover Pub.Inc., 1991)
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II. PHYSICS SPECIFIC (DSE 2):

(Credits: Theory-05, Tutorials-01)

Marks : 25 (MSE: 1Hr) + 75 (ESE: 3Hrs) =100**Pass Marks: Th (MSE +ESE) = 40*****Instruction to Question Setter for
Mid Semester Examination (MSE):***

There will be two group of questions. Group A is compulsory and will contain five questions of very short answer type consisting of 1 mark each. Group B will contain descriptive type six questions of five marks each, out of which any four are to answer.

End Semester Examination (ESE):

There will be two group of questions. Group A is compulsory and will contain two questions. Question No.1 will be very short answer type consisting of ten questions of 1 mark each. Question No.2 will be short answer type of 5 marks. Group B will contain descriptive type six questions of fifteen marks each, out of which any four are to answer.

Note: There may be subdivisions in each question asked in Theory Examinations.

CLASSICAL DYNAMICS**Theory: 75 Lectures**

The emphasis of the course is on applications in solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen.

Classical Mechanics of Point Particles:

Generalised coordinates and velocities. Hamilton's Principle, Lagrangian and Euler-Lagrange equations. Applications to simple systems such as coupled oscillators. Canonical momenta & Hamiltonian. Hamilton's equations of motion. Applications: Hamiltonian for a harmonic oscillator, particle in a central force field. Poisson brackets. Canonical transformations.

(22 Lectures)**Special Theory of Relativity:**

Postulates of Special Theory of Relativity. Lorentz Transformations. Minkowski space. Time-dilation, length contraction & twin paradox. Four-vectors: space-like, time-like & light-like. Four-velocity and acceleration. Four-momentum and energy-momentum relation. Doppler effect from a four vector perspective. Concept of four-force. Conservation of four-momentum. Relativistic kinematics. Application to two-body decay of an unstable particle. Electric and magnetic fields due to a uniformly moving charge. Equation of motion of charged particle & Maxwell's equations in tensor form. Motion of charged particles in external electric and magnetic fields.

(38 Lectures)**Electromagnetic radiation:**

Review of retarded potentials. Potentials due to a moving charge: Lienard Wiechert potentials. Electric & Magnetic fields due to a moving charge: Power radiated, Larmor's formula and its relativistic generalisation.

(15 Lectures)**Reference Books:**

- Introduction to Classical mechanics, Nikhil Ranjan Roy, 2016, Vikash Publishing House Pvt. Ltd.
- Classical Mechanics, H.Goldstein, C.P. Poole, J.L. Safko, 3rd Edn. 2002, Pearson Education.
- Mechanics, L. D. Landau and E. M. Lifshitz, 1976, Pergamon.
- Classical Electrodynamics, J.D. Jackson, 3rd Edn., 1998, Wiley.
- The Classical Theory of Fields, L.D Landau, E.M Lifshitz, 4th Edn., 2003, Elsevier.
- Introduction to Electrodynamics, D.J. Griffiths, 2012, Pearson Education.
- Classical Mechanics: An introduction, Dieter Strauch, 2009, Springer.
- Solved Problems in classical Mechanics, O.L. Delange and J. Pierrus, 2010, Oxford Press

III. CORE COURSE -C 11:

(Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) + 25 (Pr 3Hrs)=100

Pass Marks: Th (MSE +ESE) = 30 + Pr ESE =10

Instruction to Question Setter for***Mid Semester Examination (MSE):***

There will be **two** group of questions. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type** three questions of five marks each, out of which any two are to answer.

End Semester Examination (ESE):

There will be **two** group of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.

Note: There may be subdivisions in each question asked in Theory Examinations.

QUANTUM MECHANICS AND APPLICATIONS**Theory: 60 Lectures**

Time dependent Schrodinger equation: Postulates of Quantum Mechanics, Time dependent Schrodinger equation and dynamical evolution of a quantum state; Properties of Wave Function. Interpretation of Wave Function Probability and probability current densities in three dimensions; Conditions for Physical Acceptability of Wave Functions. Normalization. Linearity and Superposition Principles. Eigenvalues and Eigenfunctions. Commutator of position and momentum operators; Expectation values of position and momentum. Wave Function of a Free Particle.

(8 Lectures)

Time independent Schrodinger equation-Hamiltonian, stationary states and energy eigen values; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; Application to spread of Gaussian wave-packet for a free particle in one dimension; wave packets, Position-momentum uncertainty principle.

(12 Lectures)

General discussion of bound states in an arbitrary potential- continuity of wave function, boundary condition and emergence of discrete energy levels; application to one-dimensional problem-square well potential; Quantum mechanics of simple harmonic oscillator-energy levels and energy eigen functions using Frobenius method; Hermite polynomials; ground state, zero point energy & uncertainty principle.

(14 Lectures)

Atoms in Electric & Magnetic Fields: Electron angular momentum. Space quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Moment. Stern-Gerlach Experiment. Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton. Normal and Anomalous Zeeman Effect. Paschen Back and Stark Effect (Qualitative Discussion only).

(14 Lectures)

Hydrogen and Many electron atoms: Pauli's Exclusion Principle, Symmetric & Antisymmetric Wave Functions (Qualitative idea only). Spin orbit coupling. Spectral Notations for Atomic States. Total angular momentum. Vector Model. Spin-orbit coupling in atoms- L-S and J-J couplings. Hund's Rule. Term symbols. Spectra of Hydrogen and Alkali Atoms (Na etc.).

(12 Lectures)

Reference Books:

- Introduction to Quantum mechanics, Nikhil Ranjan Roy, 2016, Vikash Publishing House Pvt. Ltd.
- A Text book of Quantum Mechanics, P.M.Mathews and K.Venkatesan, 2nd Ed., 2010, McGraw Hill
- Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002, Wiley.
- Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGraw Hill.
- Quantum Mechanics, G. Aruldas, 2nd Edn. 2002, PHI Learning of India.
- Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.
- Quantum Mechanics: Foundations & Applications, Arno Bohm, 3rd Edn., 1993, Springer
- Quantum Mechanics for Scientists & Engineers, D.A.B. Miller, 2008, Cambridge University Press
- Quantum mechanics, Satya Prakash

Additional Books for Reference

- Quantum Mechanics, Eugen Merzbacher, 2004, John Wiley and Sons, Inc.
- Introduction to Quantum Mechanics, D.J. Griffith, 2nd Ed. 2005, Pearson Education
- Quantum Mechanics, Walter Greiner, 4th Edn., 2001, Springer

PHYSICS PRACTICAL-C 11 LAB**60 Lectures**

Use C/C++/Scilab for solving the following problems based on Quantum Mechanics like

1. Solve the s-wave Schrodinger equation for the ground state and the first excited state of the hydrogen atom:

$$d^2y/dr^2 = A(r)u(r), A(r) = 2m/h^2 \times [V(r) - E] \text{ where } V(r) = -e^2/r$$

Here, m is the reduced mass of the electron. Obtain the energy eigenvalues and plot the corresponding wavefunctions. Remember that the ground state energy of the hydrogen atom is

$$\approx -13.6 \text{ eV. Take } e = 3.795 \text{ (eV}\mathring{\text{A}})^{1/2}, \hbar c = 1973 \text{ (eV}\mathring{\text{A}}) \text{ and } m = 0.511 \times 10^6 \text{ eV}/c^2.$$

2. Solve the s-wave radial Schrodinger equation for an atom:

$$d^2y/dr^2 = A(r)u(r), A(r) = 2m/h^2 * [V(r) - E]$$

where m is the reduced mass of the system (which can be chosen to be the mass of an electron), for the screened coulomb potential $V(r) = -e^2/r \times (e^{-r/a})$

Find the energy (in eV) of the ground state of the atom to an accuracy of three significant digits. Also, plot the corresponding wavefunction. Take $e = 3.795 \text{ (eV}\mathring{\text{A}})^{1/2}$, $m = 0.511 \times 10^6 \text{ eV}/c^2$, and $a = 3 \mathring{\text{A}}, 5 \mathring{\text{A}}, 7 \mathring{\text{A}}$. In these units $\hbar c = 1973 \text{ (eV}\mathring{\text{A}})$. The ground state energy is expected to be above -12 eV in all three cases.

3. Solve the s-wave radial Schrodinger equation for a particle of mass m:

$$d^2y/dr^2 = A(r)u(r), A(r) = 2m/h^2 \times [V(r) - E]$$

For the anharmonic oscillator potential $V(r) = \frac{1}{2} kr^2 + \frac{1}{3} br^3$ for the ground state energy (in MeV) of particle to an accuracy of three significant digits. Also, plot the corresponding wave function. Choose $m = 940 \text{ MeV}/c^2$, $k = 100 \text{ MeV fm}^{-2}$, $b = 0, 10, 30 \text{ MeV fm}^{-3}$. In these units, $\hbar c = 197.3 \text{ MeV fm}$. The ground state energy I expected to lie between 90 and 110 MeV for all three cases.

4. Solve the s-wave radial Schrodinger equation for the vibrations of hydrogen molecule:

$$d^2y/dr^2 = A(r)u(r), A(r) = 2\mu/h^2 \times [V(r) - E]$$

Where μ is the reduced mass of the two-atom system for the Morse potential

$$V(r) = D (e^{-2\alpha r'} - e^{-\alpha r'}), r' = (r-r_0)/r_0$$

Find the lowest vibrational energy (in MeV) of the molecule to an accuracy of three significant digits. Also plot the corresponding wave function.

Take: $m = 940 \times 106 \text{ eV}/c^2$, $D = 0.755501 \text{ eV}$, $\alpha = 1.44$, $r_0 = 0.131349 \text{ \AA}$.

Laboratory based experiments:

5. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency
6. Study of Zeeman effect: with external magnetic field; Hyperfine splitting
7. To show the tunneling effect in tunnel diode using I-V characteristics.
8. Quantum efficiency of CCDs

Reference Books:

- Schaum's outline of Programming with C++. J.Hubbard, 2000,McGraw---Hill Publication
- Numerical Recipes in C: The Art of Scientific Computing, W.H. Pressetal., 3rd Edn., 2007, Cambridge University Press.
- An introduction to computational Physics, T.Pang, 2nd Edn.,2006, Cambridge Univ. Press
- Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific & Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández.2014 Springer.
- Scilab (A Free Software to Matlab): H. Ramchandran, A.S. Nair. 2011 S. Chand & Co.
- Scilab Image Processing: L.M.Surhone.2010 Betascript Publishing ISBN:978-6133459274

IV. CORE COURSE -C 12:

(Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) + 25 (Pr 3Hrs)=100**Pass Marks: Th (MSE +ESE) = 30 + Pr ESE =10*****Instruction to Question Setter for*****Mid Semester Examination (MSE):**

There will be **two** group of questions. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type** three questions of five marks each, out of which any two are to answer.

End Semester Examination (ESE):

There will be **two** group of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.

Note: There may be subdivisions in each question asked in Theory Examinations.

SOLID STATE PHYSICS**Theory: 60 Lectures****Crystal Structure:**

Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Unit Cell. Miller Indices. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Diffraction of X-rays by Crystals. Bragg's Law. Atomic and Geometrical Factor.

(12 Lectures)**Elementary Lattice Dynamics:**

Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids. T^3 law.

(12 Lectures)**Magnetic Properties of Matter:**

Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of Dia- and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss

(10 Lectures)**Dielectric Properties of Materials:**

Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability. Normal and Anomalous Dispersion. Cauchy and Sellmeier relations. Langevin-Debye equation. Complex Dielectric Constant.

(9 Lectures)**Elementary band theory:**

Periodic potential and Bloch Theorem, Kronig Penny model. Band Gap. Conductor, Semiconductor (P and N type) and insulator. Conductivity of Semiconductor, mobility, Hall Effect. Measurement of conductivity (04 probe method) & Hall coefficient.

(11 Lectures)**Superconductivity:**

Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, Idea of BCS theory (No derivation)

(6 Lectures)

Reference Books:

- Introduction to Solid State Physics, Charles Kittel, 8th Edition, 2004, Wiley India Pvt. Ltd.
 - Elements of Solid State Physics, J.P. Srivastava, 2nd Edition, 2006, Prentice-Hall of India
 - Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
 - Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning
 - Solid-state Physics, H. Ibach and H. Luth, 2009, Springer
 - Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India
 - Solid State Physics, M.A. Wahab, 2011, Narosa Publications
 - Solid State Physics, Dekker
 - Introduction to Solid State Physics, Arun Kumar
 - Solid State Physics, J. P. Srivastava
 - Solid State Physics, Mahan and Mahto
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PHYSICS PRACTICAL-C 12 LAB**60 Lectures**

1. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method)
2. To measure the Magnetic susceptibility of Solids.
3. Verification of Curie-Weiss Law for a ferroelectric material.
4. To measure the Dielectric Constant of a dielectric Materials with frequency
5. To determine the refractive index of a dielectric layer using SPR
6. To draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis.
7. To measure the resistivity of a semiconductor (Ge) with temperature by four-probe method (room temperature to 150⁰C) and to determine its band gap.
8. To determine the Hall coefficient of a semiconductor sample.

Reference Books

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
 - Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
 - A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
 - Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India.
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SEMESTER VI

4 Papers**Total 100 x 4 = 400 Marks****I. PHYSICS SPECIFIC (DSE 3):**

(Credits: Theory-06)

Marks : 75 (Project) + 25 (Viva) =100**Pass Marks ESE = 40*****Guidelines to Examiners for******End Semester Examination (ESE):****Evaluation of project dissertation work may be as per the following guidelines:**Project model (if any) and the Project record notebook = 75 marks**Project presentation and viva-voce = 25 marks**Overall project dissertation may be evaluated under the following heads:*

- *Motivation for the choice of topic*
- *Project dissertation design*
- *Methodology and Content depth*
- *Results and Discussion*
- *Future Scope & References*
- *Presentation style*
- *Viva-voce*

DISSERTATION

Student alone or in a group of not more than five, shall undertake one Project Dissertation approved by the Subject Teacher/H.O.D. of the Department/College concerned. The progress of the Project Dissertation shall be monitored by the faculty members at regular intervals.

II. PHYSICS SPECIFIC (DSE 4):

(Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) + 25 (Pr 3Hrs)=100**Pass Marks: Th (MSE +ESE) = 30 + Pr ESE =10*****Instruction to Question Setter for******Mid Semester Examination (MSE):***

There will be two group of questions. Group A is compulsory and will contain five questions of very short answer type consisting of 1 mark each. Group B will contain descriptive type three questions of five marks each, out of which any two are to answer.

End Semester Examination (ESE):

There will be two group of questions. Group A is compulsory and will contain two questions. Question No.1 will be very short answer type consisting of ten questions of 1 mark each. Question No.2 will be short answer type of 5 marks. Group B will contain descriptive type five questions of fifteen marks each, out of which any three are to answer.

Note: *There may be subdivisions in each question asked in Theory Examinations.*

EXPERIMENTAL TECHNIQUES**Theory: 60 Lectures****Measurements:**

Accuracy and precision. Significant figures. Error and uncertainty analysis.

Types of errors: Gross error, systematic error, random error. Statistical analysis of data (Arithmetic mean, deviation from mean, average deviation, standard deviation, chi-square) and curve fitting. Gaussian distribution.

(8 Lectures)**Signals and Systems:**

Periodic and aperiodic signals. Impulse response, transfer function

and frequency response of first and second order systems. Fluctuations and Noise in measurement system. S/N ratio and Noise figure. Noise in frequency domain. Sources of Noise: Inherent fluctuations, Thermal noise, Shot noise, 1/f noise

(8 Lectures)**Shielding and Grounding:**

Methods of safety grounding. Energy coupling. Grounding. Shielding: Electrostatic shielding. Electromagnetic Interference.

(4 Lectures)**Transducers & industrial instrumentation (working principle, efficiency, applications):**

Static and dynamic characteristics of measurement Systems. Generalized performance of systems, Zero order first order, second order and higher order systems. Electrical, Thermal and Mechanical systems. Calibration. Transducers and sensors. Characteristics of Transducers. Transducers as electrical element and their signal conditioning. Temperature transducers: RTD, Thermistor, Thermocouples, Semiconductor type temperature sensors (AD590, LM35, LM75). Linear Position transducer: Strain gauge, Linear variable differential transformer (LVDT), Capacitance change transducers. Radiation Sensors: Principle of Gas filled detector, ionization chamber, scintillation detector.

(21 Lectures)**Digital Multimeter:**

Comparison of analog and digital instruments. Block diagram of digital multimeter, principle of measurement of I, V, C. Accuracy and resolution of measurement.

(5 Lectures)**Vacuum Systems:**

Characteristics of vacuum: Gas law, Mean free path. Application of vacuum. Vacuum system-Chamber, Mechanical pumps, Diffusion pump & Turbo Modular pump, Pumping speed, Pressure gauges (Pirani, Penning, ionization).

(14 Lectures)**Reference Books:**

- Measurement, Instrumentation and Experiment Design in Physics and Engineering, M. Sayer and A. Mansingh, PHI Learning Pvt. Ltd.
 - Experimental Methods for Engineers, J.P. Holman, McGraw Hill
 - Introduction to Measurements and Instrumentation, A.K. Ghosh, 3rd Edition, PHI Learning Pvt. Ltd.
 - Transducers and Instrumentation, D.V.S. Murty, 2nd Edition, PHI Learning Pvt. Ltd.
 - Instrumentation Devices and Systems, C.S. Rangan, G.R. Sarma, V.S.V. Mani, Tata McGraw Hill
 - Principles of Electronic Instrumentation, D. Patranabis, PHI Learning Pvt. Ltd.
 - Electronic circuits: Handbook of design & applications, U.Tietze, Ch.Schenk, Springer
-

DSE-4 LAB: EXPERIMENTAL TECHNIQUES**60 Lectures**

1. Determine output characteristics of a LVDT & measure displacement using LVDT
2. Measurement of Strain using Strain Gauge.
3. Measurement of level using capacitive transducer.
4. To study the characteristics of a Thermostat and determine its parameters.
5. Study of distance measurement using ultrasonic transducer.
6. Calibrate Semiconductor type temperature sensor (AD590, LM35, or LM75)
7. Comparison of pickup of noise in cables of different types (co-axial, single shielded, double shielded, without shielding) of 2m length, understanding of importance of grounding using function generator of mV level & an oscilloscope.
8. To design and study the Sample and Hold Circuit.
9. Design and analyze the Clippers and Clampers circuits using junction diode
10. To plot the frequency response of a microphone.
11. To measure Q of a coil and influence of frequency, using a Q-meter.

Reference Books:

- Electronic circuits: Handbook of design and applications, U. Tietze and C. Schenk, 2008, Springer
- Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1990, Mc-Graw Hill
- Measurement, Instrumentation and Experiment Design in Physics & Engineering, M. Sayer and A. Mansingh, 2005, PHI Learning.

III. CORE COURSE -C 13:

(Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) + 25 (Pr 3Hrs)=100**Pass Marks: Th (MSE +ESE) = 30 + Pr ESE =10*****Instruction to Question Setter for******Mid Semester Examination (MSE):***

There will be two group of questions. Group A is compulsory and will contain five questions of very short answer type consisting of 1 mark each. Group B will contain descriptive type three questions of five marks each, out of which any two are to answer.

End Semester Examination (ESE):

There will be two group of questions. Group A is compulsory and will contain two questions. Question No.1 will be very short answer type consisting of ten questions of 1 mark each. Question No.2 will be short answer type of 5 marks. Group B will contain descriptive type five questions of fifteen marks each, out of which any three are to answer.

Note: *There may be subdivisions in each question asked in Theory Examinations.*

ELECTROMAGNETIC THEORY**Theory: 60 Lectures****Maxwell Equations:**

Review of Maxwell's equations. Displacement Current. Vector and Scalar Potentials. Gauge Transformations: Lorentz and Coulomb Gauge. Boundary Conditions at Interface between Different Media. Wave Equations. Plane Waves in Dielectric Media. Poynting vector and Poynting Theorem. Electromagnetic (EM) Energy Density.

(14 Lectures)

EM Wave Propagation in Unbounded Media:

Plane EM waves through vacuum and isotropic dielectric medium, transverse nature of plane EM waves, refractive index and dielectric constant, wave impedance. Propagation through conducting media, relaxation time, skin depth. Wave propagation through dilute plasma, electrical conductivity of ionized gases, plasma frequency, refractive index, skin depth.

(10 Lectures)**EM Wave in Bounded Media:**

Boundary conditions at a plane interface between two media. Reflection & Refraction of plane waves at plane interface between two dielectric media-Laws of Reflection & Refraction. Fresnel's Formulae for perpendicular & parallel polarization cases, Brewster's law. Reflection & Transmission coefficients. Total internal reflection, evanescent waves.

(12 Lectures)**Polarization of Electromagnetic Waves:**

Description of Linear, Circular and Elliptical Polarization. Propagation of E.M. Waves in Anisotropic Media. Double Refraction. Polarization by Double Refraction. Nicol Prism. Ordinary & extraordinary refractive indices. Production & detection of Plane, Circularly and Elliptically Polarized Light. Phase Retardation Plates: Quarter-Wave and Half-Wave Plates. Babinet Compensator and its Uses. Analysis of Polarized Light

(12 Lectures)**Rotatory Polarization:**

Optical Rotation. Biot's Laws for Rotatory Polarization. Fresnel's Theory of optical rotation. Calculation of angle of rotation. Experimental verification of Fresnel's theory. Specific rotation. Laurent's half-shade polarimeter.

(5 Lectures)**Optical Fibers:-**

Numerical Aperture. Step and Graded Indices (Definitions Only). Single and Multiple Mode Fibres (Concept and Definition Only).

(3 Lectures)**Reference Books:**

- Electromagnetic Theory, Chopra and Agarwal.
- Electromagnetics, B. B. Laud.
- Electromagnetic Theory,, Satya Prakash
- Electromagnetic Theory, Gupta and Kumar
- Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings.
- Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.
- Introduction to Electromagnetic Theory, T.L. Chow, 2006, Jones & Bartlett Learning
- Fundamentals of Electromagnetics, M.A.W. Miah, 1982, Tata McGraw Hill
- Electromagnetic field Theory, R.S. Kshetrimayun, 2012, Cengage Learning
- Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer

Additional Books for Reference

- Electromagnetic Fields & Waves, P.Lorrain & D.Corson, 1970, W.H.Freeman & Co.
- Electromagnetics, J.A. Edminster, Schaum Series, 2006, Tata McGraw Hill.
- Electromagnetic field theory fundamentals, B. Guru and H. Hiziroglu, 2004, Cambridge University Press

PHYSICS PRACTICAL-C 13 LAB**60 Lectures**

1. To verify the law of Malus for plane polarized light.
2. To determine the specific rotation of sugar solution using Polarimeter.
3. To analyze elliptically polarized Light by using a Babinet's compensator.
4. To determine the refractive Index of
 - (a) glass and
 - (b) a liquid by total internal reflection using a Gaussian eyepiece.
5. To study the polarization of light by reflection and determine the polarizing angle for air-glass interface.
6. To verify the Stefan's law of radiation and to determine Stefan's constant.
7. To determine the Boltzmann constant using V-I characteristics of PN junction diode.

Reference Books

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
- Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer

IV. CORE COURSE -C 14:

(Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) + 25 (Pr 3Hrs)=100**Pass Marks: Th (MSE +ESE) = 30 + Pr ESE =10*****Instruction to Question Setter for******Mid Semester Examination (MSE):***

There will be two group of questions. Group A is compulsory and will contain five questions of very short answer type consisting of 1 mark each. Group B will contain descriptive type three questions of five marks each, out of which any two are to answer.

End Semester Examination (ESE):

There will be two group of questions. Group A is compulsory and will contain two questions. Question No.1 will be very short answer type consisting of ten questions of 1 mark each. Question No.2 will be short answer type of 5 marks. Group B will contain descriptive type five questions of fifteen marks each, out of which any three are to answer.

Note: There may be subdivisions in each question asked in Theory Examinations.

STATISTICAL MECHANICS**Theory: 60 Lectures****Classical Statistics:**

Macrostate & Microstate, Elementary Concept of Ensemble, Phase Space, Entropy and Thermodynamic Probability, Maxwell-Boltzmann Distribution Law, Partition Function, Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression, Gibbs Paradox, Sackur Tetrode equation, Law of Equipartition of Energy (with proof) – Applications to Specific Heat and its Limitations.

(18 Lectures)

Classical Theory of Radiation:

Properties of Thermal Radiation. Blackbody Radiation. Kirchhoff's law. Stefan-Boltzmann law: Thermodynamic proof. Radiation Pressure. Wien's Displacement law. Wien's Distribution Law. Rayleigh-Jean's Law.

(9 Lectures)

Quantum Theory of Radiation:

Spectral Distribution of Black Body Radiation. Planck's Quantum Postulates. Planck's Law of Blackbody Radiation: Experimental Verification. Deduction of (1) Wien's Distribution Law, (2) Rayleigh-Jeans Law, (3) Stefan-Boltzmann Law, (4) Wien's Displacement law from Planck's law.

(5 Lectures)

Bose-Einstein Statistics:

B-E distribution law, Thermodynamic functions of a Degenerate Bose Gas, Bose Einstein condensation, properties of liquid He (qualitative description), Radiation as a photon gas and Thermodynamic functions of photon gas. Bose derivation of Planck's law.

(13 Lectures)

Fermi-Dirac Statistics:

Fermi-Dirac Distribution Law, Thermodynamic functions of a Degenerate Fermi Gas, Fermi Energy, Electron gas in a Metal, Specific Heat of Metals, Relativistic Fermi gas, White Dwarf Stars, Chandrasekhar Mass Limit.

(15 Lectures)

Reference Books:

- Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford University Press.
 - Statistical Physics, Berkeley Physics Course, F. Reif, 2008, Tata McGraw-Hill
 - Statistical and Thermal Physics, S. Lokanathan and R.S. Gambhir. 1991, Prentice Hall
 - Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986, Narosa.
 - Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer
 - An Introduction to Statistical Mechanics & Thermodynamics, R.H. Swendsen, 2012, Oxford Univ. Press
 - Statistical Mechanics, K. Huang.
-

PHYSICS PRACTICAL-C 14 LAB**60 Lectures**

Use C/C++/Scilab for solving the problems based on Statistical Mechanics like

1. Plot Planck's law for Black Body radiation and compare it with Wein's Law and Raleigh-Jeans Law at high temperature (room temperature) and low temperature.
2. Plot Specific Heat of Solids by comparing
 - (a) Dulong-Petit law,
 - (b) Einstein distribution function,
 - (c) Debye distribution function for high temperature (room temperature) and low temperatureand compare them for these two cases
3. Plot Maxwell-Boltzmann distribution function versus temperature.
4. Plot Fermi-Dirac distribution function versus temperature.
5. Plot Bose-Einstein distribution function versus temperature.

Reference Books:

- Elementary Numerical Analysis, K.E. Atkinson, 3rd Edn. 2007, Wiley India Edition
 - Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford University Press.
 - Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986, Narosa.
 - Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer
 - Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández. 2014 Springer ISBN: 978-3319067896
 - Scilab by example: M. Affouf, 2012. ISBN: 978-1479203444
 - Scilab Image Processing: L.M. Surhone. 2010, Betascript Pub., ISBN: 978-6133459274
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COURSES OF STUDY FOR **GENERIC ELECTIVE 'B. Sc. Hons'** PROGRAMME IN**"PHYSICS"****SEMESTER I****GENERIC ELECTIVE****1 Paper****Total 100 x 1 = 100 Marks****I. GENERIC ELECTIVE (GE 1):**

(Credits: Theory-04, Practicals-02)

- All Four Generic Papers (One paper to be studied in each semester) of Physics to be studied by the Students of **Other than Physics Honours**.
- Students of **Physics Honours** must Refer Content from the **Syllabus of Opted Generic Elective Subject**.

Marks : 75 (ESE: 3Hrs) + 25 (Pr 3Hrs)=100

Pass Marks: Th ESE = 30 + Pr ESE =10

*Instruction to Question Setter for**End Semester Examination (ESE):*

There will be two group of questions. Group A is compulsory and will contain two questions. Question No.1 will be very short answer type consisting of ten questions of 1 mark each. Question No.2 will be short answer type of 5 marks. Group B will contain descriptive type six questions of fifteen marks each, out of which any four are to answer.

Note: There may be subdivisions in each question asked in Theory Examinations.

MECHANICS**Theory: 60 Lectures****Vectors:**

Vector algebra. Scalar and vector products. Derivatives of a vector with respect to a parameter.

(4 Lectures)**Ordinary Differential Equations:**1st order homogeneous differential equations. 2nd order homogeneous differential equations with constant coefficients.**(6 Lectures)****Laws of Motion:**

Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass.

(10 Lectures)**Momentum and Energy:**

Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets.

(6 Lectures)**Rotational Motion:**

Angular velocity and angular momentum. Torque. Conservation of angular momentum.

(5 Lectures)**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. Basic idea of global positioning system (GPS). Weightlessness. Physiological effects on astronauts.

(8 Lectures)

Oscillations:

Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped oscillations.

(6 Lectures)**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.

(8 Lectures)**Speed Theory of Relativity:**

Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities.

(7 Lectures)

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:

- University Physics. F.W. Sears, M.W. Zemansky and H.D. Young, 13/e, 1986. Addison-Wesley
- Mechanics Berkeley Physics, v.1: Charles Kittel, et. al. 2007, Tata McGraw-Hill.
- Physics – Resnick, Halliday & Walker 9/e, 2010, Wiley
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
- A textbook of General Physics, Edser
- Oscillations and waves, Satya Prakash.
- A textbook of oscillation, waves and Acoustics, M. Ghosh and D. Bhattacharya

GE 1 LAB: MECHANICS**60 Lectures**

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
2. To determine the Moment of Inertia of a Flywheel.
3. To determine the Young's Modulus of a bar by method of bending.
4. To determine the Elastic Constants of a Wire by Searle's method.
5. To determine g by Bar Pendulum.
6. To determine g by Kater's Pendulum.
7. To study the Motion of a Spring and calculate (a) Spring Constant, (b) g .

Reference Books:

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

SEMESTER II**GENERIC ELECTIVE****1 Paper****Total 100 x 1 = 100 Marks****II. GENERIC ELECTIVE (GE 2)**

(Credits: Theory-04, Practicals-02)

Marks : 75 (ESE: 3Hrs) + 25 (Pr 3Hrs)=100**Pass Marks: Th ESE = 30 + Pr ESE =10***Instruction to Question Setter for**End Semester Examination (ESE):*

There will be two group of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** six questions of fifteen marks each, out of which any four are to answer.

Note: There may be subdivisions in each question asked in Theory Examinations.

ELECTRICITY AND MAGNETISM**Theory: 60 Lectures****Vector Analysis:**

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).

(12 Lectures)**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. 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.

(22 Lectures)**Magnetism:**

Magnetostatics: Biot-Savart's law and its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law. Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para-and ferromagnetic materials.

(10 Lectures)**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.

(6 Lectures)**Maxwell's equations and Electromagnetic wave propagation:**

Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.

(10 Lectures)

Reference Books:

- Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education
 - Electricity & Magnetism, J.H. Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press
 - Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
 - University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
 - D.J.Griffiths, Introduction to Electrodynamics, 3rd Edn, 1998, Benjamin Cummings.
 - Electricity and Magnetism, Chattopadhyaya and Rakshit
 - Electricity and Magnetism, Mahajan and Rangwala
 - Electricity and Magnetism, K. K. Tewary.
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GE 2 LAB: ELECTRICITY AND MAGNETISM**60 Lectures**

1. To use a Multimeter for measuring
 - (a) Resistances,
 - (b) AC and DC Voltages,
 - (c) DC 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. To study the Characteristics of a Series RC Circuit.
5. To study a series LCR circuit LCR circuit and determine its
 - (a) Resonant frequency,
 - (b) Quality factor
6. To study a parallel LCR circuit and determine its
 - (a) Anti-resonant frequency and
 - (b) Quality factor Q
7. To verify the Thevenin and Norton theorems
8. To verify the Superposition, and Maximum Power Transfer Theorems

Reference Books

- Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
 - Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
 - A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed.2011, Kitab Mahal
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SEMESTER III**GENERIC ELECTIVE****1 Paper****Total 100 x 1 = 100 Marks****III. GENERIC ELECTIVE (GE 3)**

(Credits: Theory-04, Practicals-02)

Marks : 75 (ESE: 3Hrs) + 25 (Pr 3Hrs)=100**Pass Marks: Th ESE = 30 + Pr ESE =10***Instruction to Question Setter for**End Semester Examination (ESE):*

There will be two group of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** six questions of fifteen marks each, out of which any four are to answer.

Note: There may be subdivisions in each question asked in Theory Examinations.

THERMAL PHYSICS AND STATISTICAL MECHANICS**Theory: 60 Lectures****Laws of Thermodynamics:**

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

(22 Lectures)**Thermodynamical Potentials:**

Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations and applications - Joule-Thompson Effect, Clausius- Clapeyron Equation, Expression for $(C_p - C_v)$, C_p/C_v , TdS equations.

(10 Lectures)**Kinetic Theory of Gases:**

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) & its applications to specific heat of gases; mono-atomic and diatomic gases.

(10 Lectures)**Theory of Radiation:**

Blackbody radiation, Spectral distribution, Concept of Energy Density, Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh- Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law.

(6 Lectures)**Statistical Mechanics:**

Maxwell-Boltzmann law - distribution of velocity – Quantum statistics - Phase space - Fermi-Dirac distribution law - electron gas - Bose-Einstein distribution law - photon gas - comparison of three statistics.

(12 Lectures)

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.
 - Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W.Sears and G.L. Salinger. 1988, Narosa
 - University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
 - Heat and Thermodynamics, A. B. Gupta and H. P. Roy.
 - Heat and Thermodynamics, P. K. Chakraborty.
 - Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford University Press.
 - Statistical Physics, Berkeley Physics Course, F. Reif, 2008, Tata McGraw-Hill
 - Statistical and Thermal Physics, S. Lokanathan and R.S. Gambhir. 1991, Prentice Hall
 - Statistical Mechanics, K. Huang.
-

GE 3 LAB: THERMAL PHYSICS AND STATISTICAL MECHANICS**60 Lectures**

1. Measurement of Planck's constant using black body radiation.
2. To determine Stefan's Constant.
3. To determine the coefficient of thermal conductivity of Cu by Searle's Apparatus.
4. To determine the coefficient of thermal conductivity of a bad conductor by Lee disc method.
5. To determine the temperature co-efficient of resistance by Platinum resistance thermometer.
6. To study the variation of thermo emf across two junctions of a thermocouple with temperature.
7. To record and analyze the cooling temperature of an hot object as a function of time using a thermocouple and suitable data acquisition system

Reference Books:

- Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
 - A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
 - A Laboratory Manual of Physics for Undergraduate Classes, D.P.Khandelwal, 1985, Vani Publication.
-

SEMESTER IV**GENERIC ELECTIVE****1 Paper****Total 100 x 1 = 100 Marks**

(Credits: Theory-04, Practicals-02)

IV. GENERIC ELECTIVE (GE 4)**Marks : 75 (ESE: 3Hrs) + 25 (Pr 3Hrs)=100****Pass Marks: Th ESE = 30 + Pr ESE =10*****Instruction to Question Setter for******End Semester Examination (ESE):***

There will be two group of questions. Group A is compulsory and will contain two questions. Question No.1 will be very short answer type consisting of ten questions of 1 mark each. Question No.2 will be short answer type of 5 marks. Group B will contain descriptive type six questions of fifteen marks each, out of which any four are to answer.

Note: There may be subdivisions in each question asked in Theory Examinations.

WAVES AND OPTICS**Theory: 60 Lectures****Wave Motion:**

Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. Water Waves: Ripple and Gravity Waves.

(6 Lectures)**Velocity of Waves:**

Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction.

(6 Lectures)**Wave Optics:**

Electromagnetic nature of light. Definition and properties of wave front. Huygens Principle. Temporal and Spatial Coherence.

(5 Lectures)**Interference:**

Division of amplitude and wavefront. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism. 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). Newton's Rings: Measurement of wavelength and refractive index.

(12 Lectures)**Interferometer:**

Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer –theory and applications.

(6 Lectures)**Diffraction:**

Kirchhoff's Integral Theorem, Fresnel-Kirchhoff's Integral formula and its application to rectangular slit.

(6 Lectures)

Fraunhofer diffraction:

Single slit. Circular aperture, Resolving Power of a telescope. Single slit. Double slit. Multiple slits. Diffraction grating. Resolving power of grating.

(10 Lectures)**Fresnel Diffraction:**

Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire.

(9 Lectures)**Reference Books**

- Waves and Acoustics, P. K. Chakraborty and Satyabrata Chowdhury.
- Introduction to Geometrical and Physical Optics, B. K. Mathur. Optics, Singh and Agarwal.
- Geometrical and Physical Optics, P. K. Chakraborty.
- Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
- Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
- Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
- Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
- The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
- The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.

GE 4 LAB: WAVES AND OPTICS**60 Lectures**

1. Familiarization with: Schuster's focusing; determination of angle of prism.
2. To determine refractive index of the Material of a prism using sodium source.
3. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
4. To determine wavelength of sodium light using Fresnel Biprism.
5. To determine wavelength of sodium light using Newton's Rings.
6. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.
7. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
8. To determine dispersive power and resolving power of a plane diffraction grating.

Reference Books

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

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Honours & General' PROGRAMME**

Distribution of Credits Semester wise for Undergraduate Honours Courses

Table B-1: UG (B.A./ B.Sc./B.Com. Hons. Programme)

Semester wise distribution of 140 Credits

	CC	AECC	GE	SEC	DSE	Total credits
Semester I	12	02	06			20
Semester II	12	02	06			20
Semester III	18		06	02		26
Semester IV	18		06	02		26
Semester V	12				12	24
Semester VI	12				12	24
	84	04	24	04	24	140

CC=Core Course; AECC=Ability Enhancement Compulsory Course; GE=Generic Elective; SEC=Skill Enhancement Course; DSE=Discipline Specific Elective

Table B-2: UG (B.A./ B.Sc./B.Com. Programme)

Semester wise distribution of 120 Credits

	CC	AECC	GE	SEC	DSE	Total credits
Semester I	18	02				20
Semester II	18	02				20
Semester III	18			02		20
Semester IV	18			02		20
Semester V				02	18	20
Semester VI				02	18	20
	72	04		08	36	120

CC=Core Course; AECC=Ability Enhancement Compulsory Course; GE=Generic Elective; SEC=Skill Enhancement Course; DSE=Discipline Specific Elective

Table B-3: Sample calculation for SGPA for B.Sc./B.A./B.Com Honours Programme

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit X Grade)	SGPA (Credit Point/Credit)
Semester I					
C-1	06	A	8	48	
C-2	06	B+	7	42	
AECC-1	02	B	6	12	
GE-1	06	B	6	36	
Total	20			138	6.9 (138/20)
Semester II					
C-3	06	B	6	36	
C-4	06	C	5	30	
AECC-2	02	B+	7	14	
GE-2	06	A+	9	54	
Total	20			134	6.7 (134/20)
Semester III					
C-5	06	A+	9	54	
C-6	06	O	10	60	
C-7	06	A	8	48	
SEC-1	02	A	8	16	
GE-3	06	O	10	60	
Total	26			238	9.15 (238/26)
Semester IV					
C-8	06	B	6	36	
C-9	06	A+	9	54	
C-10	06	B	6	36	
SEC-2	02	A+	9	18	
GE-4	06	A	8	48	
Total	26			192	7.38 (192/26)
Semester V					
C-11	06	B	6	36	
C-12	06	B+	7	42	
DSE-1	06	O	10	60	
DSE-2	06	A	8	48	
Total	24			186	7.75 (186/24)
Semester VI					
C-13	06	A+	9	54	
C-14	06	A	8	48	
DSE-3	06	B+	7	42	
DSE-4	06	A	8	48	
Total	24			192	8.0 (192/24)
CGPA					
Grand Total	140			1080	7.71 (1080/140)

Table B-4: Sample calculation for CGPA for B.Sc./B.A./B.Com Honours Programme

Semester I	Semester II	Semester III	Semester IV	Semester V	Semester VI
Credit:20; SGPA:6.9	Credit:20; SGPA: 6.7	Credit:26; SGPA: 9.15	Credit:26; SGPA: 7.38	Credit:24; SGPA: 7.75	Credit:24; SGPA: 8.0

Thus CGPA= (20x6.9+20x6.7+26x9.15+26x7.38+24x7.75+24x8.0)/140=7.71

Table B-5: Sample calculation for SGPA for B.A./B.Sc./B.Com. Program

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit X Grade)	SGPA (Credit Point/Credit)
Semester I					
DSC - 1A	06	B	6	36	
DSC - 2A	06	B+	7	42	
DSC - 3A	06	C	5	30	
AECC – 1	02	B	6	12	
Total	20			120	6.0 (120/20)
Semester II					
DSC - 1B	06	B	6	36	
DSC - 2B	06	B	6	36	
DSC - 3B	06	C	5	30	
AECC – 2	02	A+	9	18	
Total	20			120	6.0 (120/20)
Semester III					
DSC - 1C	06	A	8	48	
DSC - 2C	06	A+	9	54	
DSC - 3C	06	A	8	48	
SEC – 1	02	A	8	16	
Total	20			166	8.3 (166/20)
Semester IV					
DSC - 1D	06	C	5	30	
DSC - 2D	06	B	6	36	
DSC - 3D	06	B+	7	42	
SEC - 2	02	A+	9	18	
Total	20			126	6.3 (126/20)
Semester V					
DSE - 1A	06	B	6	36	
DSE - 2A	06	A+	9	54	
DSE - 3A	06	A	8	48	
SEC – 3	02	B	6	12	
Total	20			150	7.5 (150/20)
Semester VI					
DSE - 1B	06	B+	7	42	
DSE - 1B	06	B	6	36	
DSE - 1B	06	C	5	30	
SEC - 4	02	C	5	10	
Total	20			118	5.9 (118/20)
CGPA					
Grand Total	120			800	6.67 (800/120)

Table B- 6: Sample calculation for CGPA for B.A./B.Sc./B.Com. Program

Semester I	Semester II	Semester III	Semester IV	Semester V	Semester VI
Credit:20; SGPA: 6.0	Credit:20; SGPA: 6.0	Credit:20; SGPA: 8.3	Credit:20; SGPA: 6.3	Credit:20; SGPA: 7.5	Credit:20; SGPA: 5.9

Thus CGPA= (20x6.0+20x6.0+20x8.3+20x6.3+20x7.5+20x5.9)/120=6.67

MARKS DISTRIBUTION FOR EXAMINATIONS AND FORMAT OF QUESTION PAPERS

Marks Distribution of Mid Semester Theory Examinations:**Table No. 15:** Marks distribution of Theory Examinations of Mid Semester

Topic	Code	Full Marks	Pass Marks	Time	Group-A (Very short answer type Compulsory Questions) No. of Questions x Marks = F.M.	Group-B (Descriptive Questions with Choices) No. of Questions x Marks = F.M.	Total No. of Questions to Set	
							Group A	Group B
Mid Sem*	T15	15	6	1 Hr	5 x 1 = 5	2 (out of 3) x 5 = 10	5	3
	T25	25	10	1 Hr	5 x 1 = 5	4 (out of 6) x 5 = 20	5	6

Marks Distribution of End Semester Theory Examinations:**Table No. 16:** Marks distribution of Theory Examinations of End Semester

Topic	Code	Full Marks	Pass Marks	Time	Group-A# (Very short answer type Compulsory Questions) No. of Questions x Marks = F.M.	Group-B (Descriptive Questions with Choices) No. of Questions x Marks = F.M.	Total No. of Questions to Set	
							Group A#	Group B
End Sem	T60	60	24	3 Hrs	Q.No.1 (10x1) + 1x5 = 15	3 (out of 5) x 15 = 45	2	5
	T75	75	30	3 Hrs	Q.No.1 (10x1) + 1x5 = 15	4 (out of 6) x 15 = 60	2	6
	T100	100	40	3 Hrs	Q.No.1 (10x1) + 2x5 = 20	4 (out of 6) x 20 = 80	3	6
	T50 + T50	50X2=100	20	3 Hrs	2 x 5 = 10	2 (out of 3) x 20 = 40	2	3

Question No.1 in Group-A carries 10 very short answer type 1 Mark Questions.

Marks Distribution of Mid/End Semester Practical Examinations:**Table No. 17:** Marks distribution of Practical Examinations of End Semester

Topic	Code	Full Marks	Pass Marks	Time	Distribution of Marks			Total No. of Questions to Set
					Experiment	Record	Viva	
End Sem	P25	25	10	3 Hrs	15	5	5	
	P50	50	20	3 Hrs	30	10	10	Pr. with components of both papers
	P75	75	30	3 Hrs	45	15	15	Pr. with components of all three papers
	P100	100	40	3 Hrs	60	20	20	Pr. with components of all four papers

Abbreviations : T= Theory Examination, P= Practical Examination.

Mid Sem* : There will be 15 Marks Theory Examination in Practical Subjects and 25 Marks Theory Examination in Non-Practical Subjects/ Papers. 25 Marks Theory Examination may include 10 Marks questions from Assignment/ Project/ Tutorial where ever applicable.

Note : There may be subdivisions in each question asked in Theory Examinations.

FORMAT OF QUESTION PAPER FOR MID SEM EXAMINATION

OF

SUBJECTS WITH PRACTICAL



Ranchi University, Ranchi

Mid Sem No.Exam Year**Subject/ Code****F.M.** =15**Time**=1Hr.**General Instructions:**

समान्य निर्देश :

- i. **Group A** carries very short answer type compulsory questions.
(खंड 'A' में अत्यंत लघु उत्तरीय अनिवार्य प्रश्न हैं।)
- ii. **Answer 2 out of 3** subjective/ descriptive questions given in **Group B**.
(खंड 'B' के तीन में से किन्हीं दो विषयनिष्ठ/ वर्णनात्मक प्रश्नों के उत्तर दें।)
- iii. Answer in your own words as far as practicable.
(यथासंभव अपने शब्दों में उत्तर दें।)
- iv. Answer all sub parts of a question at one place.
(एक प्रश्न के सभी भागों के उत्तर एक साथ लिखें।)
- v. Numbers in right indicate full marks of the question.
(पूर्णांक दायीं ओर लिखे गये हैं।)

Group A

1. [5x1=5]
2.
3.
4.
5.

Group B

6. [5]
7. [5]
8. [5]

Note: There may be subdivisions in each question asked in Theory Examination.

FORMAT OF QUESTION PAPER FOR MID SEM EXAMINATION

OF

SUBJECTS WITHOUT PRACTICAL



Ranchi University, Ranchi

Mid Sem No.Exam Year

Subject/ Code

F.M. =25**Time**=1Hr.

General Instructions:

समान्य निर्देश :

- i. **Group A** carries very short answer type compulsory questions.
(खंड 'A' में अत्यंत लघु उत्तरीय अनिवार्य प्रश्न हैं।)
- ii. **Answer 4 out of 6** subjective/ descriptive questions given in **Group B**.
(खंड 'B' के छः में से किन्हीं चार विषयनिष्ठ/ वर्णनात्मक प्रश्नों के उत्तर दें।)
- iii. Answer in your own words as far as practicable.
(यथासंभव अपने शब्दों में उत्तर दें।)
- iv. Answer all sub parts of a question at one place.
(एक प्रश्न के सभी भागों के उत्तर एक साथ लिखें।)
- v. Numbers in right indicate full marks of the question.
(पूर्णांक दायीं ओर लिखे गये हैं।)

Group A

- | | |
|---------|---------|
| 1. | [5x1=5] |
| 2. | |
| 3. | |
| 4. | |
| 5. | |

Group B

- | | |
|----------|-----|
| 6. | [5] |
| 7. | [5] |
| 8. | [5] |
| 9. | [5] |
| 10. | [5] |
| 11. | [5] |

Note: There may be subdivisions in each question asked in Theory Examination.

FORMAT OF QUESTION PAPER FOR END SEM EXAMINATION

OF

AECC NH + MB COMMUNICATION



Ranchi University, Ranchi

End Sem No.Exam Year

Subject/ Code

F.M. =50**P.M.**=20**Time**=1.5Hrs.

General Instructions:

- i. **Group A** carries short answer type **compulsory** questions.
(खंड 'A' में लघु उत्तरीय अनिवार्य प्रश्न हैं।)
- ii. **Answer 2 out of 3** subjective/ descriptive questions given in **Group B**.
(खंड 'B' के तीन में से किन्हीं दो विषयनिष्ठ/ वर्णनात्मक प्रश्नों के उत्तर दें।)
- iii. Answer in your own words as far as practicable.
(यथासंभव अपने शब्दों में उत्तर दें।)
- iv. Answer all sub parts of a question at one place.
(एक प्रश्न के सभी भागों के उत्तर एक साथ लिखें।)
- v. Numbers in right indicate full marks of the question.
(पूर्णांक दायीं ओर लिखे गये हैं।)

Group A

- | | | |
|---------|--|-----|
| 1. | | [5] |
| 2. | | [5] |

Group B

- | | | |
|---------|--|------|
| 3. | | [20] |
| 4. | | [20] |
| 5. | | [20] |

Note: There may be subdivisions in each question asked in Theory Examination.

FORMAT OF QUESTION PAPER FOR END SEM EXAMINATION

OF

SUBJECTS WITH PRACTICAL



Ranchi University, Ranchi

End Sem No.Exam Year

Subject/ Code

F.M. =60**P.M.**=30 (Including Mid Sem)**Time**=3Hrs.

General Instructions:

- i. **Group A** carries very short answer type **compulsory** questions.
- ii. **Answer 3 out of 5** subjective/ descriptive questions given in **Group B**.
(खंड 'B' के पाँच में से किन्हीं तीन विषयनिष्ठ/ वर्णनात्मक प्रश्नों के उत्तर दें।)
- iii. Answer in your own words as far as practicable.
(यथासंभव अपने शब्दों में उत्तर दें।)
- iv. Answer all sub parts of a question at one place.
(एक प्रश्न के सभी भागों के उत्तर एक साथ लिखें।)
- v. Numbers in right indicate full marks of the question.
(पूर्णांक दायीं ओर लिखे गये हैं।)

Group A

- | | | |
|----|------------|-----------|
| 1. | | [10x1=10] |
| | i. | [10x1=10] |
| | ii. | |
| | iii. | |
| | iv. | |
| | v. | |
| | vi. | |
| | vii. | |
| | viii. | |
| | ix. | |
| | x. | |
| 2. | ..... | [5] |

Group B

- | | | |
|----|-------|------|
| 3. | ..... | [15] |
| 4. | ..... | [15] |
| 5. | ..... | [15] |
| 6. | ..... | [15] |
| 7. | ..... | [15] |

Note: There may be subdivisions in each question asked in Theory Examination.

FORMAT OF QUESTION PAPER FOR END SEM EXAMINATION

OF

SUBJECTS WITHOUT PRACTICAL



Ranchi University, Ranchi

End Sem No.Exam Year

Subject/ Code

F.M. =75**P.M.**=40 (Including Mid Sem)**Time**=3Hrs.

General Instructions:

- i. **Group A** carries very short answer type **compulsory** questions.
- ii. **Answer 4 out of 6** subjective/ descriptive questions given in **Group B**.
(खंड 'B' के छः में से किन्हीं चार विषयनिष्ठ/ वर्णनात्मक प्रश्नों के उत्तर दें।)
- iii. Answer in your own words as far as practicable.
(यथासंभव अपने शब्दों में उत्तर दें।)
- iv. Answer all sub parts of a question at one place.
(एक प्रश्न के सभी भागों के उत्तर एक साथ लिखें।)
- v. Numbers in right indicate full marks of the question.
(पूर्णांक दायीं ओर लिखे गये हैं।)

Group A

1. [10x1=10]
- i.
 - ii.
 - iii.
 - iv.
 - v.
 - vi.
 - vii.
 - viii.
 - ix.
 - x.

2. [5]

Group B

3. [15]
4. [15]
5. [15]
6. [15]
7. [15]
8. [15]

Note: There may be subdivisions in each question asked in Theory Examination.

FORMAT OF QUESTION PAPER FOR END SEM EXAMINATION

OF

GE, SEC, GENERAL & AECC HINDI/ ENGLISH COMMUNICATION



Ranchi University, Ranchi

End Sem No.Exam Year

Subject/ Code

F.M. =100**P.M.**=40**Time**=3Hrs.

General Instructions:

- i. **Group A** carries very short answer type **compulsory** questions.
- ii. **Answer 4 out of 6** subjective/ descriptive questions given in **Group B**.
(खंड 'B' के छः में से किन्हीं चार विषयनिष्ठ/ वर्णनात्मक प्रश्नों के उत्तर दें।)
- iii. Answer in your own words as far as practicable.
(यथासंभव अपने शब्दों में उत्तर दें।)
- iv. Answer all sub parts of a question at one place.
(एक प्रश्न के सभी भागों के उत्तर एक साथ लिखें।)
- v. Numbers in right indicate full marks of the question.
(पूर्णांक दायीं ओर लिखे गये हैं।)

Group A

- | | | |
|----|------------|-----------|
| 1. | ..... | [10x1=10] |
| | i. | |
| | ii. | |
| | iii. | |
| | iv. | |
| | v. | |
| | vi. | |
| | vii. | |
| | viii. | |
| | ix. | |
| | x. | |
| 2. | ..... | [5] |
| 3. | ..... | [5] |

Group B

- | | | |
|----|-------|------|
| 4. | ..... | [20] |
| 5. | ..... | [20] |
| 6. | ..... | [20] |
| 7. | ..... | [20] |
| 8. | ..... | [20] |
| 9. | ..... | [20] |

Note: There may be subdivisions in each question asked in Theory Examination.