DEPARTMENT OF PHYSICS

COURSE CURRICULUM & MARKING SCHEME

M.Sc. PHYSICS
Semester - II

SESSION : 2022-23

ESTD: 1958

GOVT. V.Y.T. PG AUTONOMOUS COLLEGE, DURG, 491001 (C.G.)

(Former Name – Govt. Arts & Science College, Durg)

NAAC Accredited Grade A^+, College with CPE - Phase III (UGC), STAR COLLEGE (DBT)

Phone : 0788-2212030

Website - www.govtsciencecollegedurg.ac.in, Email – autonomousdurg2013@gmail.com

DEPARTMENT OF PHYSICS
GOVT. V.Y.T. PG. AUTONOMOUS COLLEGE DURG

Programme Outcomes (POs)

At the end of M. Sc. (Physics) students will be able to:

PO1: Knowledge: Acquire an overview of concepts, fundamentals and advancements of science across a range of fields, with in-depth knowledge in at least one area of study. Develop focused field knowledge and amalgamate knowledge across different disciplines.

PO2: Complementary skills: Students will be able to engage in critical investigation through principal approaches or methods and through effective information search and evaluation strategies. Employ highly developed conceptual, analytical, quantitative and technical skills and are adept with a range of technologies

PO3: Applied learning: Students will be able to apply disciplinary or interdisciplinary learning across multiple contexts, integrating knowledge and practice. Recognize the need for information; effectively search for, evaluate, manage and apply that information in support of scientific investigation or scholarly debate

PO4:Communication: Communicate effectively on scientific achievements, basic concepts and recent developments with experts and with society at large. Able to comprehend and write reports, documents, make effective presentations by oral and/or written form.

PO5: Problem-solving: Investigate, design and apply appropriate methods to solve problems in science, mathematics, technology and/or engineering.

PO6: Environment and sustainability: Understand the impact of the solutions in ethical, societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.

PO7: Teamwork, collaborative and management skills: Recognize the opportunities and contribute positively in collaborative scientific research. Engage in intellectual exchange of ideas with researchers of other disciplines to address important research issues

Programme Specific outcomes

At the end of M. Sc. (Physics) students will be able to:

PSO1 Students are expected to acquire core knowledge in modern physics, including the major premises of classical mechanics, electromagnetic theory, and optical electronics.

PSO2 Students are also expected to develop written and oral communication skills in optical fibre communicating physics-related topics.

PSO3 Students would learn how to design and conduct an experiment (or series of experiments) demonstrating their understanding of the scientific method and processes.

PSO4 Students are expected to understand the analytical methods required to interpret and analyze results and draw conclusions as supported by the experimental data or existing theories.

Name and Signatures

V.C. Nominee	**Departmental members**
Subject Expert 26/07/2022	**1. H.O.D Dr. Jagjeet Kaur Saluja** 26.7.22
Subject Expert.....	**2. Dr. R. S. Singh** .....
Alumni (member).....	**3. Dr. Anita Shukla** .....
Prof. from other Dept. of Sc. Faculty 26/7/22	**4 Mrs. Siteshwari Chandrakar** 26/07/22
Specialist from Industry.....	**5. Dr. Abhishek Kumar Misra** .....
	6. Dr. Kusumanjali Deshmukh..... 26/07/22

DEPARTMENT OF PHYSICS
GOVT. V.Y.T. PG. AUTONOMOUS COLLEGE DURG
Approved syllabus for M.Sc. (PHYSICS) Semester II by the members of Board of Studies
For the Session 2022-23

Semester II

The syllabus with the paper combinations is as under

Paper I **MPH201: QUANTUM MECHANICS**	**Paper II** **MPH202: STATISTICAL MECHANICS**
Paper III **MPH203: ELECTRODYNAMICS**	**Paper IV** **MPH204: ATOMIC AND MOLECULAR PHYSICS**
Paper V **MPHL03: Lab Course I** **Electronics**	**Paper VI** **MPHL04: Lab Course II** **C - Programming**

*** Applicable for the concerned subjects**

The syllabus for M.Sc. (PHYSICS) II Semester is hereby approved for the session 2022-23.

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	6. Dr. Kusumanjali Deshmukh..... 26/7/22

Marking Scheme for Second Semester
Session 2022-23

Paper No.	Title of the Paper	Marks Allotted in Theory		Marks Allotted in Internal Assessment	
		Max	Min	Max.	Min.
I	MPH201: Quantum Mechanics	80	16	20	04
II	MPH202: Statistical Mechanics	80	16	20	04
III	MPH203: Electrodynamics	80	16	20	04
IV	MPH204: Atomic And Molecular Physics	80	16	20	04
V	MPHL03: Lab Course I Electronics	100	34	-	-
VI	MPHL04: Lab Course II C-Programming	100	34	-	-
	Total	520		80	

04 Theory papers	-	320
04 Internal Assessments	-	80
02 Practical	-	200
Total Marks	-	600

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1. H.O.D/.....
2. Dr. Jagjeet Kaur Saluja.....
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4. Dr. Anita Shukla.....
5. Mrs. Siteshwari Chandrakar.....
6. Dr. Abhishek Kumar Misra.....
7. Dr. K. Deshmukh

The Scheme of Internal Assessment
Session 2022-23
Semester II

Paper No.	Paper Name	Test Marks I	Test Marks II	Home Assignment III	Total
I	MPH201: QUANTUM MECHANICS	20 Marks	20 Marks	20 Marks	Average / Best of Test and Home Assignment/Seminar(20 Marks)
II	MPH202: STATISTICAL MECHANICS	20 Marks	20 Marks	Only one seminar (20 marks) Presentation (10 marks) Viva (10marks)	Average / Best of Test and Home Assignment/Seminar(20 Marks))
III	MPH203: ELECTRODYNAMICS	20 Marks	20 Marks	20 Marks	Average / Best of Test and Home Assignment/Seminar(20 Marks)
IV	MPH204: ATOMIC AND MOLECULAR PHYSICS	20 Marks	20 Marks	20 Marks	Average / Best of Test and Home Assignment/Seminar(20 Marks)

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6. Dr. Kusumanjali Deshmukh.....

Question Paper Format and Distribution of Marks for PG Semester Examination

Question paper format for the Post-Graduate Examination have the following main points
The question paper will be of **80 marks**

1) Questions will be asked Unit-wise in each question paper.
2) From each Unit, the questions will be asked as follows :

Q.1 Very short answer type question **(Answer in one or two sentences)** **(02 Marks)**
Q.2 Very short answer type question **(Answer in one or two sentences)** **(02 Marks)**
Q.3 Short answer type question **(Answer in 200-250 words)** **(04 Marks)**
Q.4 Long answer type questions **(Answer in 400-450 words)** **(12 Marks)**

Type of Question	Unit-I	Unit-II	Unit-III	Unit-IV
Very Short (2 Questions) (Maximum two sentences)	2 x 2 = 4 Marks	2 x 2 = 4 Marks	2 x 2 = 4 Marks	2 x 2 = 4 Marks
Short (1 Question) 200-250 words	1 x 4 = 4 Marks	1 x 4 = 4 Marks	1 x 4 = 4 Marks	1 x 4 = 4 Marks
Long answer (1 Question) 400-450 words	1 x 12 = 12 Marks	1 x 12 = 12 Marks	1 x 12 = 12 Marks	1 x 12 = 12 Marks

Note:

1) Question no. 1 and Question 2 will be compulsory.
2) Question no. 3 and 4 will consist of 2 optional questions of which one has to be attempted.
3) As mentioned above, two compulsory very short answer type questions (2+2 marks), one short answer type question with internal choice (4 marks) and one long answer type question with internal choice (12 marks) will be asked from each unit.
   Thus there will be questions of 20 marks from each unit and of total 80 marks from all the four units of the syllabus/syllabi.
4) Internal Assessment Examination will be as follows:
   i) Two Internal Test in each paper (20 marks).
   ii) Seminar (Power point presentation) in any one of the papers (20 marks).
   iii) Assignment in each of the remaining papers (excluding the paper of Seminar(20 marks).
   iv) Average of marks obtained in best of internal test + seminar in any one paper and marks obtained in best of internal test + assignment in rest of the papers will be calculated and taken into consideration.

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GOVT.V.Y.T.AUTO.PG COLLEGE, DURG (C.G.)
2022-23
M.Sc. (Physics) Semester-II
Paper - II
MPH201: QUANTUM MECHANICS

Course Outcomes

After completion of the course, students would able to:

CO1	Familiarize with time independent perturbation theory and Fermi-Golden rule, variation method, WKB approximation as well as adiabatic and sudden approximations.
CO2	Introduce laboratory and centre of mass frames, scattering cross-sections, partial wave analysis, Born approximation.
CO3	Develop the idea of identical particles in quantum mechanics and their collision, spin angular momentum, Pauli pin matrices, effect of identity and spin.
CO4	Understand the basic concepts of semi classical theory of radiation and electric dipole transition, line width, quantization of electromagnetic field, creation and annihilation operators, spontaneous and stimulated emissions.

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GOVT.V.Y.T.AUTO.PG COLLEGE, DURG (C.G.)
SYLLABUS FOR (2022-23)
M.Sc. (Physics) Semester-II
Paper - II
MPH201: QUANTUM MECHANICS

Min. Marks: 16 **Max. Marks.: 80**

UNIT- I Time dependent perturbation theory, Harmonic perturbation, Fermi's golden rule, Variational method and its application to calculate expectation value of the energy, WKB approximation theory and its applications, adiabatic and sudden approximations.

UNIT-II Scattering in laboratory and center of mass reference frames, scattering amplitude, differential scattering cross section and total scattering cross section, Spherically symmetric potentials, partial wave analysis and phase shifts, scattering by perfectly rigid sphere and by square well potential, Greens function, Born appximation, validity of Born approximation.

UNIT-III Identical particles, Exchange operator, Symmetric and anti-symmetric wave functions, Slater determinant, Pauli's exclusion principle, Collision of identical particles, Electron spin function.

Relativistic Quantum Mechanics: Klein-Gordon (KG) equation and its plane wave solution and equation of continuity, Dirac equation for free particle, Plane wave solutions of Dirac equation, charge and current densities, Covariant form of Dirac equation, Dirac interpretation of negative energy states and concept of antiparticles, Dirac γ- matrices and their properties.

UNIT-IV Hamiltonian and interaction term in the semi-classical theory of radiation, transition probability for absorption and induced emission, electric dipole transition, forbidden transition, Spontaneous and stimulated emission, Plank's distribution formula, line breadth, selection rules, quantization of electromagnetic field using creation and annihilation operators, transition rates for absorption and emission of radiation, Dipole approximation – transition rates with dipole approximation, electric dipole selection rules, spontaneous and stimulated emission.

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REFERENCES :

1. Introduction to Quantum Mechanics by L. Pauling & E. B. Wilson
2. Quantum Mechanics by V. K. Thankappan
3. Quantum Mechanics by L. I. Shiff
4. Quantum Mechanics - Non-relativistic Theory by L. D. Landau & E. M. Lifshitz
5. Modern Quantum Mechanics by J. J. Sakurai.
6. Quantum Mechanics – Concepts & Applications by Nouredine Zettili
7. Quantum Mechanics by Mathews and Venkatesan.

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GOVT.V.Y.T. P.G. AUTONOMOUS COLLEGE, DURG(C.G.)
2022-23
M.Sc. (Physics) Semester-II
Paper - II
MPH202: STATISTICAL MECHANICS

Course Outcomes

After completion of the course, students would able to:

CO1 Classify a system into canonical, micro canonical, Grand Canonical ensembles and write partition function for them.

CO2 Describe Gibbs's paradox, Phase space Liouvelle's theorem, Maxwellian distribution from canonical distribution and understand transition to Quantum statistical mechanics.

CO3 Derive and discuss Virial equation , cluster expansion for a classical gas,the Ising model in one dimension, exact solution of Ising model in one dimensions and Landau's Phenomenological theory of phase transition.

CO4 Summarize and outline thermodynamic fluctuations spatial correlation in a fluid, Langevin's theory of the Brownian motion, Einstein Relation and Expression for mobility(Nernst relation) Fokker – Planck equation and Fluctuation dissipation theorem.

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GOVT.V.Y.T. P.G. AUTONOMOUS COLLEGE, DURG(C.G.)
SYLLABUS FOR (2022-23)
M.Sc. (Physics) Semester-II
Paper - II
MPH202: STATISTICAL MECHANICS

Min. Marks: 16 **Max. Marks.: 80**

UNIT-I **Foundation of statistical mechanics** – Specification of the state of a system statistical ensemble, contact between statistical and thermo dynamical quantities, Micro canonical ensemble, perfect gas in micro canonical ensemble, partition function and its correlation with thermodynamic quantities nature of probability function partition function for canonical ensemble thermodynamic functions for canonical ensemble. Perfect mono atomic gas in canonical ensemble, Grand canonical ensemble: Partition function and thermo dynamic function for grand canonical ensemble, Perfect gas in grand canonical ensemble.

UNIT-II Classical ideal gas entropy of mixing, Gibbs's paradox, Phase space Liouvelle's theorem, Maxwellian distribution from canonical distribution, Transition from classical statistical mechanics to quantum statistical mechanics, indistinguishability and quantum statistics.
The density matrix, condition for statistical equilibrium, B.E., F.D. & M.B. statistics evaluation of constant α and β , Result of three statistics, Properties of ideal Bose gas, gas degeneracy, B.E. condensation, ideal fermi dirac gas – energy & pressure of gas & light and strong degeneracy.

UNIT-III **Theory of imperfect gases** – Virial equation of state Virial coefficients, cluster expansion for a classical gas. The Ising model in one dimension, exact solution of Ising model in one dimensions Phase transition, Phase transition of first and second kind, Landau's Phenomenological theory of phase transition.

UNIT-IV **Fluctuations** – Thermo dynamic fluctuations spatial correlation in a fluid, The Langevin's theory of the Brownian motion, Einstein Relation and Expression for mobility (Nernst relation) Fokker – Planck equation, Fluctuation dissipation theorem.

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REFERENCES:

1 Statistical and thermal Physics by F.Reif.
2 Statistical Mechanics by K.Huang.
3 Statistical Mechanics by R.K.Patharia.
4 Statistical Mechanics by Landau & Lifshiz.
5 Statistical Mechanics by Bhattacharya.

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GOVT.V.Y.T. P.G. AUTONOMOUS COLLEGE, DURG (C.G.)
2022-23
M.Sc. (Physics) Semester-II
Paper - III
MPH203: ELECTRODYNAMICS

Course Outcomes

After completion of the course, students would able to:

CO1 Review and illustrate Lorentz transformation of space and time and Maxwell's field equations in terms of four vectors, electromagnetic field tensor, Lienard -Wiechert Potential.

CO2 Explain Motion of charged particles in E-M field and theories related to Larmour's formula, relativistic generalization of Larmour's formula, Bremrstrahlung radiation, Synchrotron Radiation, Cerenkev radiation, Abraham- Lorentz formula.

CO3 Explain propagation of EMW in free space and extend the idea for conducting and dielectric media and hence build the concept of wave guide and its modes.

CO4 Implement Lagrangian for EMW and analyze results obtained for interacting particles

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GOVT.V.Y.T. P.G. AUTONOMOUS COLLEGE, DURG (C.G.)
SYLLABUS FOR (2022-23)
M.Sc. (Physics) Semester-II
Paper - III
MPH203: ELECTRODYNAMICS

Min. Marks: 16 **Max. Marks: 80**

UNIT-I Review of four vectors, Lorentz transformation of space and time in four-vector form. Maxwell's field equations in terms of four vectors, vector potential and scalar potential, electromagnetic field tensor, Maxwell's equations in covariance four tensor form, Lorentz Transformation of electric and magnetic Fields, The invariants of the electromagnetic field, Retarded potential, Lienard Wiechert potentials.

UNIT-II Electric and Magnetic fields due to a uniformly moving charge, variation of accelerated charge at low velocity - Larmour's formula, relativistic generalization of Larmour's formula, Bremrstrahlung radiation, Synchrotron Radiation, Cerenkov radiation, Angular distribution of radiation emitted by an accelerated charge, radiation damping- Abraham- Lorentz formula.

UNIT-III **Electromagnetic waves and its interaction with matter on macroscopic scale :** Electromagnetic waves (EMW) in free space, propagation of EMW in isotropic, anisotropic dielectrics, in conducting media, Boundary conditions, Fresnel formulae, Propagation of EMW between conducting planes, Wave guides : TE and TM mode, Rectangular and cylindrical wave guides, cavity resonator.

UNIT-IV **Lagrangian Formulation of Electrodynamics :** Lagrangian for a free relativistic particle, for a charge particle in an e.m. field, for free electromagnetic field, for interacting charged particles and fields, Energy-momentum tensor and related conservation laws.

REFERENCES :

1. Introduction to Electrodynamics by David J. Griffith
2. Classical Electricity & Magnetism by Panofsky & Phillips.
3. Classical Electrodynamics by J.D. Jackson.
4. Principles of Electrodynamics by Melvin Schwartz,
5. Classical Electrodynamics by J. Schwinger, L.L. Derrad, K.L. Milton, W.Y. Tsai, J. Norton.
6. Modern Problems in Classical Electrodynamics by Charles A. Brau,
7. Electrodynamics of Continuous Media by L. D. Landau and E. M. Lifshitz and L.P. Pitaevskii,
8. Electrodynamics : An introduction including quantum effects by H.J.W. Mueller-Kirsten.

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GOVT.V.Y.T. P.G. AUTONOMOUS COLLEGE, DURG (C.G.)
2022-23
M.Sc. (Physics) Semester-II
Paper-IV
MPH204: ATOMIC AND MOLECULAR PHYSICS

Course Outcomes

After successful completion of the course, the student would be able to:

CO1	know about different atom model and will be able to differentiate different atomicsystems, different coupling schemes and their interactions with magnetic and electric fields.
CO2	Have gained ability to apply the techniques of microwave and infraredspectroscopy to elucidate the structure of molecules
CO3	Be able to apply the principle of Raman spectroscopy and its applications in the differentfield of science & Technology.
CO4	To become familiar with different resonance spectroscopic techniques and its applications to find solutions to problems related different spectroscopic systems.

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GOVT.V.Y.T. P.G. AUTONOMOUS COLLEGE, DURG (C.G.)
SYLLABUS FOR (2022-23)
M.Sc. (Physics) Semester-II
Paper-IV
MPH204: ATOMIC AND MOLECULAR PHYSICS

Min. Marks: 16 **Max. Marks: 80**

UNIT-I Stationary energy states, radiation terms, continuous spectra, quantum numbers of the individual electrons the Pauli's Principle, quantum theoretical addition of angular momentum vectors, quantum numbers and angular momentum of the whole atom, term Symbols, influence of a magnetic or electric field, selection rules, nuclear spin.

UNIT-II Atomic Orbital, Hydrogen Spectrum (Bohr theory, Sommerfeld theory and Sommerfeld Relativistic Correction), Spectrum of alkali elements Different Series of Alkali atoms , spin orbit interaction & fine Structure in alkali spectra , Normal and anomalous Zeeman effect, Paschen Back effect, Stark effect, Two electron system, Interaction energy in LS and JJ coupling.

UNIT-III The rigid rotator – The molecules as a rigid rotator, energy eigen values, Eigen function, spectrum. The non-rigid rotator energy levels,
The diatomic molecules as symmetric to, asymmetric top and spherical top molecule, angular momenta, energy levels, Eigen functions, infrared spectrum.

UNIT-IV The diatomic molecule as anharmonic oscillator, energy levels, Eigen functions, spectrums. Molecules as Vibrating rotator, Vibration spectrum of diatomic molecule, P, Q and R branches, Applications of vibrational spectroscopy.
Infra-red spectrum, general experimental arrangement for studying infrared spectra.

REFERENCE:

1. Introduction to atomic spectra- H.E.White
2. Fundamental of spectroscopy – C.B.Banwell.
3. Spectra of diatomic molecules – Herzbeng
4. Molecular structure & Spectroscopy – G.Aruldhas.

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GOVT.V.Y.T. P.G. AUTONOMOUS COLLEGE, DURG (C.G.)

2022-23

M.Sc. (Physics) Semester- II

Paper - V

MPHL03: LAB-COURSE I ELECTRONICS

Course Outcomes

Students are expected to understand various theory and applications concerned with semiconductor electronics and will be able to :

CO1	Design and resolve circuits for electronic applications.
CO2	Record data as required by the experimental objectives.
CO3	Analyse recorded data and formulate it to get desired results.
CO4	Interpret results and check for attainment of proposed objective.

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GOVT.V.Y.T. P.G. AUTONOMOUS COLLEGE, DURG (C.G.)
SYLLABUS FOR (2022-23)
M.Sc. (Physics) Semester- II
Paper - V
MPHL03: LAB-COURSE I - ELECTRONICS

Min. Marks: 34 **Max. Marks: 100**

Scheme of Marks:

Max. Marks: 100 marks
Expt : 60 marks
Sessional: 20 marks
Viva: 20 marks

List of Experiments

Any 10 of the following or similar experiments of equal standard are to be performed.

1. Design of Regulated Power supply.
2. Design of C-E Amplifier.
3. Design & Study of Negative feed back amplifier. (Voltage & Current)
4. Design & Construction of Astable, Monostable, Bistable Multivibrators.
5. Characteristics & applications of S.C.R.
6. FET & MOSFET Characterization and Application as an Amplifier.
7. Study of UJT & its application.
8. Digital-I Basic logic Gates, T.T.L.NAND, NOR gates.
9. Digital-II Combinational Logic Gates.
10. Flip- Flop's : J K, RS
11. Application of Operational Amplifier (741)
12. Differential Amplifier.

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Alumni (member).....	**3. Dr. Anita Shukla** .....
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Specialist from Industry.....	**5. Dr. Abhishek Kumar Misra** .....
	6. Dr. Kusumanjali Deshmukh.....

GOVT.V.Y.T. P.G. AUTONOMOUS COLLEGE, DURG (C.G.)
SYLLABUS FOR (2022-23)
M.Sc. (Physics) Semester- II
Paper - VI
MPHL04: LAB-COURSE II - C PROGRAMMING

Min. Marks: 33 **Max. Marks: 100**

Course Outcomes
Students will be able to:

CO1	Write Program in C- Language for a given problem.
CO2	Execute and run the program successfully.
CO3	Debug the errors notified during the run.
CO4	Compare and appreciate the software programming.

Name and Signatures

V.C. Nominee	**Departmental members**
Subject Expert 26/07/2022	**1. H.O.D Dr. Jagjeet Kaur Saluja** 26/7
Subject Expert.....	**2. Dr. R. S. Singh** .....
Alumni (member).....	**3. Dr. Anita Shukla** .....
Prof. from other Dept. of Sc. Faculty 26/7/22	**4 Mrs. Siteshwari Chandrakar** 26/7/22
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	6. Dr. Kusumanjali Deshmukh..... 26/7/22

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Min. Marks: 33 **Max. Marks: 100**

Scheme of Marks:

Max. Marks: 100 marks
Expt : 60 marks
Sessional: 20 marks
Viva: 20 marks

List of Experiments

1 Write a program to convert the temperature from Celsius to Fahrenheit.
2 Write a program to convert the temperature from Fahrenheit to Celsius.
3 Write a program that prints the even numbers from 1 to 100.
4 Write a program that computes and prints a table of factorials for any given number n.
5 Write a program to calculate and print the first n Fibonacci numbers.
6 Write a program to calculate simple interest.
7 Write a program for simple interest of three sets of principal amount, rate and number of years.
8 Write a program to sort numbers in ascending order.
9 Write a program to sort numbers in descending order.
10 Write a program to accept three numerical values and print the biggest number out of this.
11 Write a program to input an integer through key board and then to find out whether it is odd or even number.
12 Write a program to print two numbers.
13 Write a program for solving two simultaneous equations.

REFERENCES:

1. Programming in Ansi C by E- Balagurusamy
2. Let us C by Jayant Kanetkar

Name and Signatures

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