University of Mumbai

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Academic Authorities,
Meetings & Services (AAMS)
Room No. 128, M. G. Road, Fort,
Mumbai – 400 032.
Tel. 022-68320033

Re- accredited with A ++ Grade (CGPA 3.65) by NAAC
Category- I University Status awarded by UGC

No.2026/May/AAMS-III/C- 72/42955 Date: 08th May, 2026

CIRCULAR:-

Attention of all the Principals of the Affiliated Colleges & Autonomous Colleges, all Academic Heads of University Departments, the Directors of the Recognized Institutions/Centers, Director, Centre for Distance & Online Education, Director, Dharmaveer Anand Dighe Thane Sub-Campus, Co-ordinator, School of Engineering and Applied Sciences, Kalyan Sub-Campus, Director, Chitrakar Padmabhushan Dr.Dhananjay Keer Ratnagiri Sub-Campus, Director, Sindhudurg Sub-Campus, Principal, Vishwabhushan Bharatratna Dr. B. A. Ambedkar College, Ambadave, Ratnagiri and Principal, V.V. Dalvie College, Talere, Sindhudurg is invited to this office Circular No. AAMS/ICD/2025-26/ 37 of dated 27 May, 2025 relating to the NEP UG & PG Syllabus.

They are hereby informed that the recommendations made by the **Board of Studies in Physics** at its meeting held on 26th January, 2026 vide item No.1 and subsequently passed by the Board of Deans at its meeting held on 11th February, 2026 vide item No.6.20 (N) have been accepted by the Academic Council at its meeting held on 25th March, 2026 **vide** item No.6.20 (N). In accordance therewith syllabus of **B.Sc. (Physics) (Scheme – III) (Sem V & VI)** (NEP 2020) is introduced as per appendix with effect from the academic year 2026-27.

(The said circular is available on the University's website www.mu.ac.in).

(Dr. Prasad Karande)
REGISTRAR

MUMBAI – 400 032
08th May, 2026

To,

All the Principals of the Affiliated Colleges & Autonomous Colleges, all Academic Heads of University Departments, the Directors of the Recognized Institutions/Centers, Director, Centre for Distance & Online Education, Director, Dharmaveer Anand Dighe Thane Sub-Campus, Co-ordinator, School of Engineering and Applied Sciences, Kalyan Sub-Campus, Director, Chitrakar Padmabhushan Dr.Dhananjay Keer Ratnagiri Sub-Campus, Director, Sindhudurg Sub-Campus, Principal, Vishwabhushan Bharatratna Dr. B. A. Ambedkar College, Ambadave, Ratnagiri and Principal, V.V. Dalvie College, Talere, Sindhudurg.

AC./6.20(N)/25/3/2026

Copy forwarded with Compliments for information to:-

1) The Chairman, Board of Deans,
2) The Dean, Faculty of Science,
3) The Chairman, **Board of Studies in Board of Studies in Physics**
4) The Director, Board of Examinations and Evaluation,
5) The Director, Department of Students Development,
6) The Director, Department of Information & Communication Technology,
7) The Director, Centre for Distance and Online Education (CDOE)Vidyanagari,
8) The Deputy Registrar, Admission, Enrolment, Eligibility & Migration Department (AEM),

Copy forwarded for information and necessary action to :-	
1	The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Dept)(AEM), dr@eligi.mu.ac.in
2	The Deputy Registrar, Result unit, Vidyanagari drresults@exam.mu.ac.in
3	The Deputy Registrar, Marks and Certificate Unit,. Vidyanagari dr.verification@mu.ac.in
4	The Deputy Registrar, Appointment Unit, Vidyanagari dr.appointment@exam.mu.ac.in
5	The Deputy Registrar, CAP Unit, Vidyanagari cap.exam@mu.ac.in
6	The Deputy Registrar, College Affiliations & Development Department (CAD), deputyregistrar.uni@gmail.com
7	The Deputy Registrar, PRO, Fort, (Publication Section), Pro@mu.ac.in
8	The Deputy Registrar, Executive Authorities Section (EA) eau120@fort.mu.ac.in He is requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to the above circular.
9	The Deputy Registrar, Research Administration & Promotion Cell (RAPC), rapc@mu.ac.in
10	The Deputy Registrar, Academic Appointments & Quality Assurance (AAQA) dy.registrar.tau.fort.mu.ac.in ar.tau@fort.mu.ac.in
11	The Deputy Registrar, College Teachers Approval Unit (CTA), concolsection@gmail.com
12	The Deputy Registrars, Finance & Accounts Section, fort draccounts@fort.mu.ac.in
13	The Deputy Registrar, Election Section, Fort drelection@election.mu.ac.in
14	The Assistant Registrar, Administrative Sub-Campus Thane, thanesubcampus@mu.ac.in
15	The Assistant Registrar, School of Engg. & Applied Sciences, Kalyan, ar.seask@mu.ac.in
16	The Assistant Registrar, Ratnagiri Sub-centre, Ratnagiri, ratnagirisubcentar@gmail.com
17	The Director, Centre for Distance and Online Education (CDOE), Vidyanagari, director@idol.mu.ac.in
18	Director, Innovation, Incubation and Linkages, Dr. Sachin Laddha pinkumanno@gmail.com
19	Director, Department of Lifelong Learning and Extension (DLLE), dlleuniversityofmumbai@gmail.com

Copy for information :-	
1	P.A to Hon'ble Vice-Chancellor, vice-chancellor@mu.ac.in
2	P.A to Pro-Vice-Chancellor pvc@fort.mu.ac.in
3	P.A to Registrar, registrar@fort.mu.ac.in
4	P.A to all Deans of all Faculties
5	P.A to Finance & Account Officers, (F & A.O), camu@accounts.mu.ac.in

To,

1	The Chairman, Board of Deans pvc@fort.mu.ac.in
2	**Faculty of Humanities,** **Offg. Dean** 1. Prof.Anil Singh Dranilsingh129@gmail.com **Offg. Associate Dean** 2. Prof.Manisha Karne mkarne@economics.mu.ac.in 3. Dr.Suchitra Naik Naiksuchitra27@gmail.com
	Faculty of Commerce & Management, **Offg. Dean,** 1 Prin.Ravindra Bambardekar principal@model-college.edu.in **Offg. Associate Dean** 2. Dr.Kavita Laghate kavitalaghate@jbims.mu.ac.in 3. Prin.Kishori Bhagat kishoribhagat@rediffmail.com

	Faculty of Science & Technology **Offg. Dean** 1. Prof. Shivram Garje ssgarje@chem.mu.ac.in **Offg. Associate Dean** 2. Dr. Madhav R. Rajwade Madhavr64@gmail.com 3. Prin. Deven Shah sir.deven@gmail.com
	Faculty of Inter-Disciplinary Studies, **Offg. Dean** 1.Dr. Anil K. Singh aksingh@trcl.org.in **Offg. Associate Dean** 2.Prin.Chadrashekhar Ashok Chakradeo cachakradeo@gmail.com 3. Dr. Kunal Ingle drkunalingle@gmail.com
3	Chairman, Board of Studies,
4	The Director, Board of Examinations and Evaluation, dboee@exam.mu.ac.in
5	The Director, Board of Students Development, dsd@mu.ac.in DSW direcotr@dsw.mu.ac.in
6	The Director, Department of Information & Communication Technology, director.dict@mu.ac.in

AC – 25/03/2026
Item No. – 6.20 (N)

As Per NEP 2020

University of Mumbai

Syllabus for Major Vertical – 1, 4, & 6 (Scheme - III)		
Faculty of Science and Technology		
Board of Studies in Physics		
Name of the Programme – B. Sc. (Physics)		
U. G. Third Year Programme	**Exit Degree**	**B. Sc. (Physics)**
Semester	**V & VI**	
From the Academic Year	**2026 - 2027**	

University of Mumbai

(As per NEP 2020)

Sr. No.	Heading	Particulars
1	Title of program O: _____	B. Sc. (Physics)
2	Exit Degree	B. Sc. (Physics)
3	Scheme of Examination R: _____	NEP 40% Internal 60% External, Semester End Examination Individual Passing in Internal and External Examination
4	Standards of Passing R: _____	40%
5	Credit Structure R: SU – 520 E (III) R: SU – 520 F (III)	Attached herewith
6	Semesters	Sem V & VI
7	Program Academic Level	5.5
8	Pattern	Semester
9	Status	New
10	To be implemented from Academic Year Progressively	2026 - 2027

NOTE: This Syllabus is applicable to IDOL students as well, w.e.f. 2026 - 2027

Sd/-	Sd/-	Sd/-
Sign of the	Sign of the	Sign of the Offg. Dean
Prof. (Dr.) T. N. Ghorude	Offg. Associate Dean	Prof. Shivram S. Garje
Chairman	Dr. Madhav R. Rajwade	Faculty of Science &
BOS in Physics	Faculty of Science &	Technology
	Technology	

Preamble

1) **Introduction:**

The revised syllabus in Physics, as per credit-based system for the Third Year B.Sc course will be implemented from the academic year 2026-2027. This program is designed to provide a basic understanding of Physics. In addition to imparting knowledge, our academic program of theory and practical courses will certainly inspire the learner to study physics.

2) **Aims and Objectives**

The aims and objectives of the B. Sc (Physics) course are designed to provide students with understanding of the principles and applications of Physics. The systematic and planned curricula from these courses shall motivate and encourage learners to understand basic concepts of Physics. The broader educational goals and objectives, having main emphasis on the intellectual, and professional growth will help the learners to enrich their knowledge through problem-solving, hands-on activities, study visits, projects etc.

3) **Learning Outcomes**

The Semester V and VI will initiate a process to continuous learning and self-improvement of students and acquiring the following skills:

The students will get opportunity to study the following courses in SEM - V:

1. Thermal and Statistical Physics
2. Solid State Physics
3. IKS
4. Physics Major Practical – V
5. Physics Major Practical – VI
6. VSC(Practical)
7. CC
8. CEP

While in SEM VI, the students will get the exposure in the following areas of physics:

1. Classical Physics
2. Nuclear Physics
3. Special Theory of Relativity
4. Electronics
5. Atomic and Molecular Physics
6. Physics Major Practical – VII
7. Physics Major Practical – VIII
8. OJT

The objectives and outcomes of the courses mentioned above are mentioned at appropriate places along with the syllabus and other relevant details of each course.

In addition to imparting knowledge, our academic program of theory and practical courses will create an interest, among the students, towards physics.

B. Sc. Physics
Scheme – III
Credit Structure (SEM. V & VI)

B. Sc. – Major & Minor

R: SU – 520 E (III)

Vertical		1	2		3	4	5	6		
(Level)	Semester	Major		Minor	OE	VSC, SEC, (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC, RP	Cum Cr. / Sem	Degree / Cum. Cr.
		Mandatory	Electives							
5.5	V	10 Thermal and Statistical Physics (2) Solid State Physics (2) Physics Major Practical – V (2) Physics Major Practical – VI (2) IKS in Physics in Vedic Science and Indian Scientists (2)	4 Elective (EL – I); Electronic Instrumentation – I (2) OR Elective (EL-I): Computer Science-I (2) Elective (ELP – I): Electronic Instrumentation Practical – I (2) OR Elective (ELP-I): Computer Science Practical- I (2)	2	----	VSC: 2 Study of Solar Panel and its Installation (2)	---	CEP: 2 CC-2	22	**U. G. Degree** **132**
	R: SU – 520 F (III)									
	VI	10 Classical Physics (2) Nuclear	4 (2+2) Elective (EL – II);	4 (2+2)	---	---	---	OJT: 4	22	

	Physics (2) Special Theory of Relativity (2) Atomic and Molecular Physics (2) Physics Major Practical – VII (2) Physics Major Practical – VIII (2)	Electronic Instrumentation – II (2) OR Elective (EL-II): Computer Science – II (2) Elective (ELP – II): Electronic Instrumentation Practical – II (2) OR Elective (ELP-II): Computer Science Practical – II (2)						
Cum Cr.	**44**	**8**	**28**	**10**	**8+6**	**8+4+2**	**4+2+2 2+4**	**132**

Exit option: Award of UG Degree in Major with 132 credits OR continue with Major

[Abbreviation - OE – Open Electives, VSC – Vocation Skill Course, SEC – Skill Enhancement Course, (VSEC), AEC – Ability Enhancement Course, VEC – Value Education Course, IKS – Indian Knowledge System, OJT – on Job Training, FP – Field Project, CEP – Community Engagement Project, CC – Co-Curricular, RP – Research Project]

[* 2 Credit IKS Major paper (Core Subject Specific Theory may be included in Sem III or V]

Program Structure for Sem. V & VI
(NEP 2020)

Vertical No		Paper Title	Credits
Sem. V			
1	Mandatory	1. Thermal and Statistical Physics	2
		2. Solid State Physics	2
		3. Physics Major Practical – V	2
		4. Physics Major Practical – VI	2
		5. IKS in Physics in Vedic Science and Indian Scientists	2
3	Electives	1. Elective (EL – I); Electronic Instrumentation – I OR Elective (EL-I): Computer Science-I	2
		2. Elective (ELP – I): Electronic Instrumentation Practical – I OR Elective (ELP-I): Computer Science Practical- I	2
2	Minor (To be selected from other discipline)		2
4	VSC (Practical)	Study of Solar Panel and its installation	2
6	CEP (To be selected from CEP topic list)		2
7	CC		2
		Credits	22
Sem. VI			
1	Mandatory	1. Classical Physics	2
		2. Nuclear Physics	2
		3. Special Theory of Relativity	2
		4. Electronics	2
		5. Atomic and Molecular Physics	2
		6. Physics Major Practical – VII	2
		7. Physics Major Practical – VIII	2
3	Electives	1. Elective (EL – II); Electronic Instrumentation – II OR Elective (EL-II): Computer Science - II	2
		2. Elective (ELP – II): Electronic Instrumentation Practical – II OR Elective (ELP-II): Computer Science Practical - II	2
6.	VI	OJT	4
		Credits	22
		Total Credits	44

SEM. – V

Vertical – 1 Major Mandatory (2+2+2+2+2)

Name of the Course: T. Y. B. Sc. Physics Major Course 7
MJ - 7: Thermal & Statistical Physics (2 Credits)

Sr. No.	Heading			Particulars
1	Description the course (Including but Not limited to)		:	Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc.
2	Vertical		:	**Major**/Minor/Open Electives /Skill Enhancement / Ability Enhancement/Indian Knowledge System
3	Type		:	**Theory**
4	Credits		:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	Hours Allotted		:	30 Hours
6	Marks Allotted		:	50 Marks
7	Course Objectives (CO): The students are expected to:			
	CO 1.	to develop a fundamental understanding of thermal interactions, adiabatic processes, thermodynamic potentials, and Maxwell's relations		
	CO 2.	Study the basics of the quantum and classical theories of specific heat of solids.		
	CO 3.	develop a strong foundation in classical and quantum statistical distributions such as Maxwell-Boltzmann, Bose-Einstein, and Fermi-Dirac statistics.		
	CO 4.	understand the basic concept of probability, independent events and various kinds of statistical distributions.		
	CO 5.	get exposure to important ideas of statistical mechanics.		
8	Course Outcomes (OC): After successful completion of the course, the student will be able to:			
	OC 1.	explain and apply the concepts of thermal interactions, entropy, thermodynamic potentials, and use maxwell's relations to solve thermodynamic problems		
	OC 2.	compare the classical, Einstein, and Debye theories of specific heat and interpret the temperature dependence of heat capacity in solids.		
	OC 3.	understand statistical distributions like Maxwell Boltzmann Distribution, Bose Einstein Distribution, Fermi Dirac Distribution etc.		
	OC 4.	acquire fundamental knowledge of probability.		
	OC 5.	understand problem solving skills in all the topics covered.		
9	**Modules / Units**: - There will be One Module / Unit Per Credit			
	Module I / Unit I: Thermal Physics (15 Hours)			
	Thermal & Adiabatic Interactions: Thermal Interactions, Canonical distributions, Entropy of a system in a Heat Bath, Adiabatic interactions & Enthalpy, Magnetic work, Thermodynamic potentials, Maxwell's Thermodynamic relations, the difference $C_p - C_v$. **LG: 2.1, 2.3, 2.5,2.7, 4.3,4.7 ,4.8,4.9** Specific Heat of Solids: Thermal vibrations- Frequencies, Thermal Vibrations-Amplitude, Specific Heats of Solids, The Einstein Theory, The Debye Theory, Electronic Specific Heat. **AB: 19.1,19.2,19.3,19.4,19.5,19.8**			
	Module II / Unit II: Statistical Physics: (15 Hours)			

<table>
<tr><td></td><td colspan="3">The probability of a distribution, The most probable distribution, Maxwell-Boltzmann statistics, Molecular speeds. Bose-Einstein statistics, The Planck radiation formula, Fermi-Dirac statistics, Comparison of results.

AB:15.2, 15.3,15.4, 15.5, 16.1,16.4,16.5, 16.6

Microstates and configurations, derivation of Boltzmann distribution, dominance of Boltzmann distribution, physical meaning of the Boltzmann distribution law, definition of the canonical ensemble.

ER:13.1,13.2,13.4, 14.1</td></tr>
<tr><td>10</td><td colspan="3">Reference Books:
1. AB: Perspectives of Modern Physics: Arthur Beiser, (Mc Graw Hill International).
2. LG: Statistical and Thermal Physics, An Introduction (Prentice Hall of India 1991) by S. Lokanathan and R. S. Gambhir
3. ER: Thermodynamics, Statistical Thermodynamics and Kinetics: T. Engel and P. Reid (Pearson).

Additional References Books:
1. A Treatise on heat: Saha and Srivastava (Indian press, Allahabad)
2. Statistical Physics: F. Reif (Berkeley Physics Course, McGraw Hill)
3. Introductory Statistical Mechanics: R. Bowley and M. Sanchez (Oxford Science Publications).
4. An Introduction to Thermal Physics: D. V. Schroeder (Pearson).</td></tr>
<tr><td>11</td><td colspan="2">Internal Continuous Assessment: 40%
(20 Marks)</td><td>External Assessment: (60%)
(30 Marks)</td></tr>
<tr><td>12</td><td colspan="2">Continuous Evaluation through: Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc. (at least 3)</td><td>Evaluation: through Exam at the End of the Semester / Term.</td></tr>
<tr><td>13</td><td colspan="3">Format of Question Paper for Semester End Examination
Total Marks: 30 Marks Duration: One Hour</td></tr>
<tr><td></td><td>Module I / Unit-I
15 Marks</td><td>Q.1 A) Attempt any Two (Each carry 05 Marks)
i) Theory
ii) Theory
iii) Theory
iv) Theory</td><td>10 Marks</td></tr>
<tr><td></td><td></td><td>Q.1 B) Attempt any One (Each carry 05 Marks)
i) Problem / Theory
ii) Problem</td><td>05 Marks</td></tr>
<tr><td></td><td>Module I / Unit-II
15 Marks</td><td>Q.2 A) Attempt any Two (Each carry 05 Marks)
i) Theory
ii) Theory
iii) Theory
iv) Theory</td><td>10 Marks</td></tr>
<tr><td></td><td></td><td>Q.2 B) Attempt any One (Each carry -5 Marks)
i) Problem / Theory
ii) Problem</td><td>05 Marks</td></tr>
</table>

Name of the Course: T. Y. B. Sc. Physics Major Course 8
MJ - 8: Solid State Physics (2 Credits)

Sr. No.	Heading		Particulars
1	Description the course (Including but Not limited to)	:	Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc.
2	Vertical	:	**Major**/Minor/Open Electives /Skill Enhancement / Ability Enhancement/Indian Knowledge System
3	Type	:	**Theory**
4	Credits	:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	Hours Allotted	:	30 Hours
6	Marks Allotted	:	50 Marks
7	Course Objectives (CO): The students are expected to:		
	CO 1.		learn the basic structure of crystals, including lattice points, unit cells, and crystal systems.
	CO 2.		understand common metallic crystal structures, like SC, BCC, FCC) and calculate their basic properties. Also develop the skill to describe crystallographic directions and planes using Miller indices.
	CO 3.		introduce the phenomenon of superconductivity, its types, physical properties, and applications.
	CO 4.		introduce the quantum theory of free electrons and explain its significance in the electrical behaviour of metals.
	CO 5.		provide understanding of Fermi-Dirac statistics and band theory of solid. Also differentiate between conductors, insulators, and semiconductors using band theory
8	Course Outcomes (OC): After successful completion of the course, the student will be able to:		
	OC 1.		understand and explain the basic concepts of space lattices, unit cells, primitive cells, and crystal systems.
	OC 2.		identify and compare metallic crystal structures (SC, BCC, FCC, and HCP) and compute lattice-related parameters. Use Miller indices to describe crystal planes and directions.
	OC 3.		explain superconductivity and distinguish between Type I and Type II superconductors.
	OC 4.		apply the Sommerfeld free electron model to describe electron behavior in a metal and analyze limitations of the classical free electron theory.
	OC 5.		describe electron behaviour in solids using quantum models and explain energy bands of metal, semiconductors, and insulators.
9	**Modules / Units**: - There will be One Module / Unit Per Credit		
	Module I / Unit I: Crystal Physics and Superconductivity (15 Hours)		
	Crystal Physics: Lattice points and Space lattice, Unit Cells, Primitive Cells, and lattice parameters, Crystal Systems, The Bravais space lattices, Metallic Crystal Structures (SC, BCC, FCC), Relation between the density of crystal material and lattice constant in a cubic lattice, Directions, Planes, Miller Indices, Distribution of atoms in atomic planes in a simple cubic crystal, separation between planes in a cubic crystal. Superconductivity: Survey, Mechanism of Superconductors, Critical Currents, The Meissner effect, The penetration depth, Type I and Type II Superconductors, Applications of		

	superconductivity (SQUIDS, MRI-Magnetic resonance imaging, Maglev train) **SOP: CH 4 - II, III, IV, V, VI, XIV, XV, XVI, XVIII, XI, XXI, XXII** **SOP: CH 8 – II, III, IV, VI, VII, XII, XIII, XXIV, XXV**		
	Module II / Unit II: **Electrical Properties of Metals** (15 Hours)		
	Quantum theory of free electrons: Somerfield free electron model, Potential energy box, Fermi Dirac statistics and electronic distribution in solids, Density of energy states and Fermi energy, The Fermi distribution function, Mean energy of electron gas at 0 K, Electrical conductivity from quantum mechanical considerations, Failure of Sommerfeld's free electron Theory. Band theory of solids: Band theory of solids, The Kronig- Penney model (Omit solution of determinant), Brillouin zones, Number of wave functions in a band, Motion of electrons in a one-dimensional periodic potential, Distinction between metals, insulators and intrinsic semiconductors. **SOP: CH 6 – V, XIV, XV, XVI, XVIII, XX, XXXV, XXXVI to XXXXI**		
10	**Reference Books:** 1. SOP: Solid State Physics by S. O. Pillai New Age International Publishers Revised Sixth Edition **Additional Reference Books:** 1. Solid State Physics-Structure and Properties of Materials by M. A. Wahab Narosa Publishing House 3rd edition. 2. Elementary Solid State Physics-Principles and Applications by M.Ali Omar, Pearson Education, 2012. 3. Modern Physics and Solid State Physics: Problems and solutions by S.O. Pilla, New Age International. 4. Solid State Physics: A. J. Dekker, Prentice Hall 5. Solid State Physics: Ashcroft & Mermin, Harcourt College Publisher.		
11	**Internal Continuous Assessment: 40%** (20 Marks)	**External Assessment, (60%) (30 Marks)**	
12	**Continuous Evaluation through:** Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc. (at least 3)	**Evaluation:** through Exam at the End of the Semester / Term.	
13	Format of Question Paper for Semester End Examination Total Marks: **30 Marks** Duration: **One Hour**		
	Module I / Unit-I 15 Marks	Q.1 A) Attempt any Two (Each carry 05 Marks) i) Theory ii) Theory iii) Theory iv) Theory	10 Marks
		Q.1 B) Attempt any One (Each carry 05 Marks) i) Problem / Theory ii) Problem	05 Marks
	Module II / Unit-II 15 Marks	Q.2 A) Attempt any Two (Each carry -5 Marks) i) Theory ii) Theory iii) Theory iv) Theory	10 Marks

		Q.2 B) Attempt any One (Each carry -5 Marks) i) Problem / Theory ii) Problem	05 Marks

SEMESTER V
Physics Major Practical Course (MJP -V)

Sr. No.	Heading	Particulars
1	Description the course (Including but not limited to)	Introduction, Relevance, Usefulness, Application, Interest, Connection with other courses, Demand in the Industry, Job Prospects etc.
2	Vertical:	**Major**/Minor/Open Electives /Skill Enhancement / Ability Enhancement/Indian Knowledge System
3	Type:	**Practical**
4	Credits:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a Semester)
5	Hours:	**60** Hours
6	Marks Allotted:	**50** Marks
7	Course Objective (CO): The students are expected to	
	CO 1	learn the skills while performing experiments.
	CO 2	know how to use the apparatus without fear & hesitation.
	CO 3	learn the concepts of physics theory concepts and their practical application
	CO 4	learn the errors and their estimation.
8	Course outcomes (OC): After successful completion of this course, the students will be able to:	
	OC 1	understand & practice the skills while performing experiments.
	OC 2	understand the use of apparatus and their use without fear & hesitation.
	OC 3	correlate the physics theory concepts to practical application.
	OC 4	understand the concept of errors and their estimation.
9	**List of Experiments:** 1. Searle's Goniometer 2. Elastic constants of a rubber tube 3. Edser's 'A' pattern 4. Determination of wavelength by Step slit 5. Velocity of sound in air using CRO 6. Determination of e/m by Thomson's method 7. To determine the Resolving Power of a Prism. 8. To determine the wavelength of Sodium Light using Plane Diffraction Grating. 9. Stefan's constant σ 10. Double refraction 11. Determination of Rydberg's constant 12. Diode as temperature sensor **Skill Experiments:** 1. Estimation of errors from actual experimental data 2. Optical Leveling of Spectrometer 3. Schuster's method 4. Laser beam profile 5. Use of electronic balance: Find the density of a solid cylinder 6. Plotting of graph using Origin software Note: Teacher should follow the above guidelines to conduct skill experiment **Minimum 8 experiments from the list of experiments and minimum 4 skill experiments must be completed and reported in the journal.**	

Exemption: Exemption of two experiments may be given, if student carries out any one or more than one of the following activities:

- If the student collects & reports the information of at least five Physicists with their work or any three events on physics, in the journal.
- If the student executes a mini project to the satisfaction of teacher in-charge of practical.
- If the student participates in a study tour or visit & submit a study tour report.

General Instructions:

- All the measurements and readings should be written with proper units in SI system only.
- After completing all the required number of experiments in the semester and recording them in journal, student will have to get their journal certified and produce the certified journal at the time of practical examination to be eligible to appear in the Semester End Practical Examination
- While evaluating practical, weightage should be given to diagram, observations, tabular representation, experimental skills and procedure, graph, calculation and result.
- Skill of doing the experiment and its concepts should be more important than the accuracy of result.

Instruction Regarding Semester End Practical Examination

- For practical examinations, the learner will be examined in **One experiment** from the list of experiments.
- Evaluation in viva voce will be based on regular experiments and skill experiments.
- A candidate will be allowed to appear for the Semester End Practical Examination only if the candidate submit a certified journal at the time of practical examination or provide a certificate from the Head of the Department / Institute to the effect that the candidate has completed the practical course of that semester of T.Y.B. Sc. Physics as per the minimum requirement

10 **Reference Books:**

1. An Advanced course in Practical Physics by D. Chattopadhyay, P. C. Rakshit & B. Saha (8th Edition) Book & Allied Pvt. Ltd.
2. BSc Practical Physics: Harnam Singh. S. Chand & Co. Ltd. – 2001.
3. A Text book of Practical Physics: Samir Kumar Ghosh New Central Book Agency (4th edition).
4. B Sc. Practical Physics: C. L. Arora (1st Edition) – 2001 S. Chand & Co. Ltd
5. Practical Physics: C. L. Squires – (3rd Edition) Cambridge University Press
6. University Practical Physics: D C Tayal. Himalaya Publication.
7. Advanced Practical Physics: Worsnop & Flint.

11 **Scheme of Examination:**

Semester End Practical Examination:

- The duration of Each Experiment in Semester End External Practical Examination will be of **Two hours.**
- The Semester End External Practical Examination will be for **30 marks** as per the marking scheme given below:

Sr. No.	Activity	Total 30 Marks
1	One Experiments	20 Marks
2	Certified Journal	05 Marks
3	Viva	05 Marks

Internal Practical Examination:

- The duration of Internal Practical Examination per experiment will be of **Two hours.**

- The Internal Practical Examination Pattern for **20 marks** (During the Semester), will be as per the marking scheme given below:

Sr. No.	**Activity**	**Total 20 Marks**
1	Skill testing related any One Experiment	10 Marks
2	Overall performance	05 Marks
3	Viva-Voce	05 Marks

SEMESTER V
Physics Major Practical Course (MJP -VI)

Sr. No.	Heading	Particulars
1	Description the course (Including but not limited to)	Introduction, Relevance, Usefulness, Application, Interest, Connection with other courses, Demand in the Industry, Job Prospects etc
2	Vertical:	**Major**/Minor/Open Electives /Skill Enhancement / Ability Enhancement/Indian Knowledge System
3	Type:	**Practical**
4	Credits:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a Semester)
5	Hours:	**60 Hours**
6	Marks Allotted:	**50 Marks**
7	Course Objective (CO): The students are expected to	
	CO 1	develop a strong experimental foundation by performing practicals.
	CO 2	understand the theoretical principles behind each experiment and relate them to real-world applications.
	CO 3	learn accurate data recording, tabulation, graphical representation, and scientific reporting.
	CO 4	cultivate a scientific attitude, precision, and safety consciousness while working in a laboratory environment
8	Course outcomes (OC): After successful completion of this course, the students will be able to:	
	OC 1	perform physics experiments independently using standard laboratory equipment and techniques.
	OC 2	prepare clear, accurate laboratory reports and present experimental findings effectively.
	OC 3	demonstrate improved laboratory skills such as instrument handling, calibration, troubleshooting, and safe working practices.
	OC 4	apply experimental knowledge to real-life physical systems and further scientific investigations.
9	**List of Experiments:** 1. Determination of M/C by using BG 2. Maxwell's L/C bridge 3. To determine the Hall Coefficient and Carrier Concentration of a Semiconductor 4. Study of transistorized astable multivibrator 5. Design and study of transistorized bistable multivibrator 6. Application of Op-Amp as a window comparator 7. Application of Op-Amp as a Log amplifier 8. Wein Bridge Oscillator using OP – AMP 9. Arithmetic Circuits: 4 – bit Addition & Subtraction using IC 7483 & IC 7486 10. Photodiode and Phototransistor Characteristics 11. To draw the B - H curve of iron rod by using a Solenoid and to determine the energy loss due to Hysteresis 12. LM-317 as variable voltage source **Skill Experiments:** 1. Digital storage oscilloscope (DSO): Amplitude, Period and Phase shift measurement 2. Internal resistance of voltage and current source 3. Dual trace CRO: Phase shift measurement	

	4. Build and test an RC time circuit: measure charge /discharge curve on DSO 5. Build and test half-adder and full- adder circuit & verify truth table. Note: Teacher should follow the above guidelines to conduct skill experiment **Minimum 8 experiments from the list of experiments and minimum 4 skill experiments must be completed and reported in the journal.** **Exemption:** Exemption of two experiments may be given, if student carries out any one or more than one of the following activities: • If the student collects & reports the information of at least five Physicists with their work or any three events on physics, in the journal. • If the student executes a mini project to the satisfaction of teacher in-charge of practical. • If the student participates in a study tour or visit & submit a study tour report. **General Instructions:** • All the measurements and readings should be written with proper units in SI system only. • After completing all the required number of experiments in the semester and recording them in journal, student will have to get their journal certified and produce the certified journal at the time of practical examination to be eligible to appear in the Semester End Practical Examination • While evaluating practical, weightage should be given to diagram, observations, tabular representation, experimental skills and procedure, graph, calculation and result. • Skill of doing the experiment and its concepts should be more important than the accuracy of result. **Instruction Regarding Semester End Practical Examination** • For practical examinations, the learner will be examined in **One experiment** from the list of experiments. • Evaluation in viva voce will be based on regular experiments and skill experiments. • A candidate will be allowed to appear for the Semester End Practical Examination only if the candidate submit a certified journal at the time of practical examination or provide a certificate from the Head of the Department / Institute to the effect that the candidate has completed the practical course of that semester of T.Y.B. Sc. Physics as per the minimum requirement.
10	**Reference Books:** 1. An Advanced course in Practical Physics by D. Chattopadhyay, P. C. Rakshit & B. Saha (8th Edition) Book & Allied Pvt. Ltd. 2. BSc Practical Physics: Harnam Singh. S. Chand & Co. Ltd. – 2001. 3. Text book of Practical Physics: Samir Kumar Ghosh , New Central Book Agency (4th edition). 4. B Sc. Practical Physics: C. L. Arora (1st Edition) – 2001 S. Chand & Co. Ltd 5. Practical Physics: C. L. Squires – (3rd Edition) Cambridge University Press 6. University Practical Physics: D C Tayal. Himalaya Publication. 7. Advanced Practical Physics: Worsnop & Flint.
11	**Scheme of Examination:**
	Semester End Practical Examination: • The duration of Each Experiment in Semester End External Practical Examination will be of **Two hours.**

- The Semester End External Practical Examination will be for **30** marks as per the marking scheme given below:

Sr. No.	Activity	Total 30 Marks
1	One Experiments	20 Marks
2	Certified Journal	05 Marks
3	Viva	05 Marks

Internal Practical Examination:

- The duration of Internal Practical Examination per experiment will be of **Two hour**.
- The Internal Practical Examination Pattern for **20 marks** (During the Semester), will be as per the marking scheme given below:

Sr. No.	Activity	Total 20 Marks
1	Skill testing related any One Experiment	10 Marks
2	Overall performance	05 Marks
3	Viva-Voce	05 Marks

IKS
(2)

Name of the Course: Physics Major Course 9
MJ – 9: IKS: Physics in Indian Knowledge Systems (2 Credits)

Sr. No.	Heading		Particulars
1	Description the course (Including but Not limited to)	:	Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc.
2	Vertical	:	**Major**/Minor/Open Electives /Skill Enhancement / Ability Enhancement/**Indian Knowledge System**
3	Type	:	**Theory**
4	Credits	:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	Hours Allotted	:	30 Hours
6	Marks Allotted	:	50 Marks
7	Course Objectives (CO): The students are expected to		
	CO 1.	Understand ancient Indian methods of astronomical timekeeping and celestial measurements.	
	CO 2.	Analyze and predict planetary positions, eclipses, and Yutis using traditional and modern tools.	
	CO 3.	Explore the scientific and cultural significance of Panchang and ancient astronomical concepts.	
	CO 4.	Bridge historical knowledge with contemporary physics through hands-on observational techniques.	
8	Course Outcomes (OC): After completing the course, the students will be able to		
	OC 1.	appreciate ancient Indian astronomical techniques and their applications.	
	OC 2.	develop hands-on skills in predicting celestial phenomena using modern tools like Stellarium.	
	OC 3.	integration of traditional knowledge with modern physics and astronomy.	
9	**Modules / Units:** There will be one Module / Unit Per Credit		
	Module 1 / Unit I: Celestial Predictions and Measurements 15 Hours		
	Basic Framework of Indian Astronomy: Concepts of the celestial sphere, ecliptic, and equatorial systems, Ancient Indian perspectives on the motion of celestial bodies. Time and Calendar Systems: Solar and lunar calendars in Indian tradition, Intercalation methods (Adhik Maas) and their scientific basis, Introduction to Panchang: Tithi, Nakshatra, and Karana. Planetary and Stellar Positions: Observing and predicting the positions of planets and stars, Use of Nakshatras as a reference for celestial measurements. Epicycles and Geometric Models: Explanation of planetary motion using epicycles and eccentric circles, Comparisons with modern elliptical orbits. Practical Applications in Ancient Astronomy: Calculating solstices, equinoxes, and seasonal changes, Determining auspicious times using celestial data. **Reference Book:** Indian Astronomy: An Introduction by S. Balachandra Rao (Celestial Predictions and Measurements: Introduction to Celestial Sphere and Ecliptic Systems: Pages 5–12., Time and Calendar Systems: Pages 35–42, Nakshatras and their Role: Pages 43–48, Planetary and Stellar Positions: Pages 49–53, Epicycles and Geometric Models: Pages 54–61)		
	Module II / Unit II: Eclipses, Conjunctions, and Astronomical Distances -15 Hours		

<table>
<tr><td></td><td colspan="3">Eclipses in Indian Astronomy: Types of eclipses: Solar and lunar, Predictions using ancient Indian methods (Aryabhatiya, Surya Siddhanta), Role of parallax and shadow geometry Conjunctions and Yutis: Understanding planetary conjunctions (Yutis) and their significance, Observing and recording celestial intersections Astronomical Distances and Scaling: Concepts of angular measurement in celestial objects, Techniques to estimate distances between celestial bodies Tools and Techniques in Ancient Astronomy: Gnomons, water clocks, and celestial charts, Applications of these tools in distance measurement and prediction, Integration with Modern Tools: Simulating eclipses and conjunctions using Stellarium, Bridging ancient methods with modern astronomical software.</td></tr>
<tr><td>10</td><td colspan="3">Reference Book: Indian Astronomy: An Introduction by S. Balachandra Rao (Eclipses, Conjunctions, and Astronomical Distances: Eclipses in Indian Astronomy: Pages 65–72, Prediction Techniques for Eclipses: Pages 73–78, Yutis (Conjunctions) and Significance: Pages 79–83, Parallax and Shadow Geometry: Pages 84–90, Angular Measurements and Distances: Pages 91–95)</td></tr>
<tr><td>11</td><td colspan="2">Internal Continuous Assessment: 40%
(20 Marks)</td><td>External Assessment, (60%)
(30 Marks)</td></tr>
<tr><td>12</td><td colspan="2">Continuous Evaluation through: Test/ Individual/Group Project and Presentation/ Participation in Lectures and Seminars, Webinars/Book review/ Symposium/ Panel Discussion / Field Visit/ Report Writing.</td><td>Evaluation: through Exam at the End of the Semester / Term.</td></tr>
<tr><td rowspan="5">13</td><td colspan="3">Format of Question Paper for Semester End Examination
Total Marks: 30 Marks Duration: One Hour</td></tr>
<tr><td rowspan="2">Module I / Unit I
15 Marks</td><td>Q.1 A) Attempt any Two (Each carry -5 Marks)
i) Theory
ii) Theory
iii) Theory
iv) Theory</td><td>10 Marks</td></tr>
<tr><td>Q.1 B) Attempt any one (Each carry -5 Marks)
i) Problem /Theory
ii) Problem /Theory</td><td>05 Marks</td></tr>
<tr><td rowspan="2">Module II / Unit II
15 Marks</td><td>Q.2 A) Attempt any Two (Each carry -5 Marks)
i) Theory
ii) Theory
iii) Theory
iv) Theory</td><td>10 Marks</td></tr>
<tr><td>Q.2 B) Attempt any one (Each carry -5 Marks)
i) Problem /Theory
ii) Problem /Theory</td><td>05 Marks</td></tr>
</table>

Vertical – 1
Electives
(2+2)

Name of the Course: Elective (EL – I: Electronic Instrumentation - I (2 Credits)

Sr. No.	Heading		Particulars
1	Description the course (Including but Not limited to)	:	Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc.
2	Vertical	:	**Major**/Minor/Open Electives /Skill Enhancement / Ability Enhancement/Indian Knowledge System
3	Type	:	**Theory**
4	Credits	:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	Hours Allotted	:	30 Hours
6	Marks Allotted	:	50 Marks
7	Course Objectives (CO): The students are expected to:		
	CO 1.	To understand the difference between a transducer and a sensor.	
	CO 2.	To understand the construction, working and uses of different types of transducers.	
	CO 3.	To understand the concept of signal conditioning, devices used and their operations.	
	CO 4.	To get acquainted with the measuring instruments used in laboratory.	
	CO 5.	Get the insight of the electronics principles and techniques used in modern medical instruments.	
8	Course Outcomes (OC): After successful completion of the course, the student will be able to		
	OC 1.	Effective use of sensors and transducers in modern instrumentation.	
	OC 2.	Obtaining knowledge of transducers based on their construction and working in various practical applications.	
	OC 3.	Knowledge of designing the signal conditioning circuits as per the requirement of devices.	
	OC 4.	Get knowledge of the construction, and working of microphones, loudspeakers, and optoelectronic display devices for which will help in further development in instrumentation.	
	OC 5.	Use knowledge of data acquisition systems, converters, and medical instruments in practical applications in day-to-day life.	
9	**Modules / Units**: - There will be One Module / Unit Per Credit		
	Module I / Unit I: Transducers, Sensors and Optoelectronic Devices, Signal Conditioning (15 Hours)		
	Transducers: Definition, Classification, Selection of transducer. **Electrical transducers:** Thermistor, Thermocouple, Pressure Transducer: Strain gauges (wire, foil, & semiconductor), Displacement transducer: LVDT. **Chemical sensors:** Gas sensor (Fundamental aspects), Humidity sensor (Resistive) **Optoelectronic Devices:** LDR, LED (Construction, Working & Applications), Multicolour LED, Seven Segment Display, Photodiode (Construction, Characteristics & applications), Phototransistor. Half wave precision rectifier, Active Peak detector, Active Positive Clamper [M & B], Active Positive and Negative Clippers. **Microphones:** characteristics, types (list only), carbon microphone and dynamic type microphone (principle, construction and working). **Loudspeakers:** Characteristics, Dynamic (Moving coil type) speaker, Multi way speaker system (woofer and tweeter).		

	Module II / Unit II: Data Acquisition, Modern Techniques and Appliances (15 Hours)	
	Data acquisition system: Objectives of DAS, Signal conditioning of inputs, Single channel Data Acquisition system, Multichannel Data Acquisition system. **D to A Converters:** Resistive divider network, Binary ladder Network. **A to D Converters:** Successive approximation type, Voltage to Time (Single slope, Dual slope). **Microwave Oven:** Operating principle, block diagram, features. **Medical instruments:** Bio-Potential, Types of electrodes, ECG, CT scan and MRI (principle, block diagram and features), Ultrasonography: working principle.	
10	**Reference Books:** 1. A Textbook of Applied Electronics – R S Sedha, S Chand & Company, New Delhi. 2. Basic Electronics Solid state - B. L. Thereja, S Chand & Company, New Delhi. 3. Electronic Instrumentation – H S Kalsi, Tata McGraw-Hill Publishing Company Limited, New Delhi. 4. Measurement and Instrumentation Principles: Alan S. Morris, Butterworth-Heinemann. 5. Transducers and display systems: B. S. Sonde, Tata McGraw-Hill Publishing Company Limited, New Delhi. 6. Digital principles and applications: A.P. Malvino and D. P. Leach. Tata McGraw-Hill. 7. Data Converters– B. S. Sonde, Tata McGraw-Hill Publishing Company Limited, New Delhi. 8. Modern Electronic Instruments and Measurement techniques- Albert D. Helfrick, Willam D. Cooper, Prentice Hall India Pvt. Ltd, New Delhi. 9. A course in electrical and electronic Measurements and Instrumentation: A. K. Sawhney, Dhanpat Rai and Sons. 10. https://www.scribd.com/document/258017718/A-K-sawhney-A-Course-in-Electrical-and-Electronic-Measurements-and-Instrumentation 11. Instrumentation Devices & Systems, 2nd Edition Tata McGrawHill- C.S. Rangan, G.R. Sarma, V.S. Mani. 12. Consumer Electronics R. P. Bali, Pearson Education (2008). 13. S. P. Bali, "Consumer Electronics", Pearson Education Asia Pvt., Ltd., 2008 Edition. 14. Introduction to Bio-medical Electronics: Joseph-Du-bary, McGraw Hill Co. Ltd. 15. Medical instrumentation Application and design- J. C. Wobster 16. Biomedical instruments and measurements – L. Cromwell, F. J. Weibel, 17. Printice hall of India of India Pvt. Ltd, New Delhi.	
11	**Internal Continuous Assessment: 40% (20 Marks)**	**External Assessment: (60%) (30 Marks)**
12	**Continuous Evaluation through:** Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc. (at least 3)	**Evaluation:** through Exam at the End of the Semester / Term.
13	Format of Question Paper for Semester End Examination Total Marks: **30 Marks** Duration: **One Hour**	

	Module I / Unit-I 15 Marks	Q.1 A) Attempt any Two (Each carry 05 Marks) i) Theory ii) Theory iii) Theory iv) Theory	10 Marks
		Q.1 B) Attempt any One (Each carry 05 Marks) i) Problem /Theory ii) Problem	05 Marks
	Module II / Unit-II 15 Marks	Q.2 A) Attempt any Two (Each carry 05 Marks) i) Theory ii) Theory iii) Theory iv) Theory	10 Marks
		Q.2 B) Attempt any One (Each carry 05 Marks) i) Problem / Theory ii) Problem	05 Marks

Name of the Course: Elective (EL - I): Computer Science - I (2 Credits)

Sr. No.	Heading		Particulars
1	Description the course (Including but Not limited to)	:	Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc.
2	Vertical	:	**Major**/Minor/Open Electives /Skill Enhancement / Ability Enhancement/Indian Knowledge System
3	Type	:	**Theory**
4	Credits	:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	Hours Allotted	:	30 Hours
6	Marks Allotted	:	50 Marks
7	Course Objectives (CO): The students are expected to:		
	CO 1.	to get the opportunity to study the fundamental concepts of microcontrollers, processor architectures, and embedded system components with emphasis on the 8051 microcontrollers.	
	CO 2.	to develop the ability to understand the 8051's instruction set and write simple assembly language programs for embedded applications.	
	CO 3.	to explore the basics of Python Programming and understand components of Python Program	
	CO 4.	to learn how to use control structures in Python	
	CO 5.	to study the built in data structures in Python	
8	Course Outcomes (OC): After successful completion of the course, the student will be able to:		
	OC 1.	Understand the fundamental concepts, architecture, and memory organization of the 8051 Microcontroller.	
	OC 2.	Develop and analyze basic assembly language programs using the 8051's instruction set and addressing modes.	
	OC 3.	Ability to store, manipulate and access data in Python	
	OC 4.	Ability to work with data structures.	
	OC 5.	Ability to learn how to write functions and pass arguments in Python and understand recursive functions. .	
9	**Modules / Units**: - There will be One Module / Unit Per Credit		
	Module I / Unit I: 8051 Microcontroller (15 Hours)		
	(i) Introduction to Microcontrollers: Introduction, Microcontrollers and Microprocessors, History of Microcontrollers and Microprocessors, Block diagram of 8051 Microcontroller*, Embedded Versus External Memory Devices, 8-bit & 16-bit Microcontrollers, CISC and RISC Processors, Harvard and Von Neumann Architectures, Commercial Microcontrollers. AVD-Ch: 1 MMM - For * Refer 1.2 **(ii) 8051 Microcontrollers:** Introduction, MCS-Architecture, Registers in MCS-51,8051 Pin Description, 8051 Connections, 8051 Parallel I/O Ports, Memory Organization. **AVD-Ch: 2, 3** **(iii)8051 Instruction Set and Programming: MCS-51 Addressing Modes and Instructions: 8051 Addressing modes, MCS-51 Instruction Set, 8051 Instructions and Simple Programs, Using Stack Pointer** **AVD-Ch: 4**		

	Module II / Unit II: Python Programming (15 Hours)
	Introduction to Python: What is Python? Reasons for popularity, what sets Python apart, where is Python used? Functional programming model, Procedural programming model, Object Oriented Programming model, Event driven programming model. **Getting Started:** Python Installation, Python resources, Third party packages. **Python Basics:** Identifiers and Keywords, Python types, Basic Types, Integer and float ranges, Variable type and Assignment, Arithmetic operators, Precedence and Associativity, Conversions Built in functions, Built in modules, Comments and indentation. **Strings and Regular Expressions:** What are Strings? Accessing String elements, String properties, Built-in Functions, String methods, String Comparisons, Regular expressions, Regex functionality, Regex Metacharacters, Regex Repetition qualifiers. Regex anchors, Regex grouping **Decision Control Instruction:** Decision control instruction, Nuances of conditions, Logical operators, Conditional expressions, receiving input, pass statement. **Repetition Control Instruction:** Repetition control instruction, while loop, for loop, break and continue, else block of a loop. **Console Input /Output:** Console input, Console output, Formatted printing **Lists:** What are Lists, Accessing List elements, Looping in Lists, Basic List operations, Using Built-in Functions on Lists, List methods, Sorting and reversing, list varieties. **Tuples:** What are tuples, accessing tuple elements, looping in tuple, Basic tuple operations, Using Built-in Functions on tuples, tuple methods, tuple varieties. **Sets:** What are Sets, accessing set elements, Looping in Sets, Basic Set operations, Using Built-in Functions on Sets, set methods, Mathematical Set operations, Updating Set operations, Set varieties. **Dictionaries:** What are Dictionaries, accessing dictionary elements, looping in dictionaries, Basic dictionary operations, Using Built-in Functions on dictionaries, Dictionary methods, Dictionary varieties. **Functions:** What are functions, Communication with functions, Types of arguments, unpacking arguments **Recursion:** Repetitions, Recursive functions, when to use recursion, Recursive factorial function, Problem with unknown loops, types of recursion, Recursion limit, Iteration to recursion **YK: Chapter 14**
10	**Reference Books:** 1. **AVD:** Microcontrollers (Theory and Applications) by Ajay V Deshmukh, The Tata-McGraw-Hill Companies. 2. **MMM:** The 8051 Microcontroller & Embedded Systems by M.A. Mazidi, J.G. Mazidi and R. D. Mckinlay, Second Edition, Pearson **3. Intel's 8031/8051 Data sheet** 4. **YK:** Yashavant Kanetkar, Aditya Kanetkar: Let Us Python, 7th Edition **Additional Reference Books:** 1. The 8051 Microcontroller & Embedded Systems-Dr. Rajiv Kapadia (Jaico Pub. House) 2. 8051 Micro-Controller by K. J. Ayala, Penram International. 3. Programming & customizing the 8051 Microcontroller by Myke Predko, TMH. 4. Paul Gries, et al., Practical Programming: An Introduction to Computer Science Using Python 3, Pragmatic Bookshelf, 2/E 2014 5. Python Programming for Students: Mahesh Bhave & Sunil Patekar, Shroff Publishers & Distributers Pvt Ltd. First Edition August 2021 6. Starting out with Python, Tony Gaddis, Fourth Edition Pearson 7. Python Programming, Anurag Gupta, G Biswas, 1st Edition McGraw Hill

<table>
<tr><td></td><td colspan="3">8. The Complete Reference: Python Martin C Brown, 1st Edition</td></tr>
<tr><td>11</td><td colspan="2">Internal Continuous Assessment: 40%
(20 Marks)</td><td>External Assessment: (60%)
(30 Marks)</td></tr>
<tr><td>12</td><td colspan="2">Continuous Evaluation through:
Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc. (at least 3)</td><td>Evaluation: through Exam at the End of the Semester / Term.</td></tr>
<tr><td rowspan="5">13</td><td colspan="3">Format of Question Paper for Semester End Examination
Total Marks: 30 Marks Duration: One Hour</td></tr>
<tr><td rowspan="2">Module I /
Unit-I
15 Marks</td><td>Q.1 A) Attempt any Two (Each carry 05 Marks)
i) Theory
ii) Theory
iii) Theory
iv) Theory</td><td>10 Marks</td></tr>
<tr><td>Q.1 B) Attempt any One (Each carry 05 Marks)
i) Problem / Theory
ii) Problem</td><td>05 Marks</td></tr>
<tr><td rowspan="2">Module II /
Unit-II
15 Marks</td><td>Q.2 A) Attempt any Two (Each carry 05 Marks)
i) Theory
ii) Theory
iii) Theory
iv) Theory</td><td>10 Marks</td></tr>
<tr><td>Q.2 B) Attempt any One (Each carry -5 Marks)
i) Problem / Theory
ii) Problem</td><td>05 Marks</td></tr>
</table>

Elective (ELP – I): Electronic Instrumentation Practical - I (2 Credits)

Sr. No.	Heading	Particulars
1	Description the course (Including but not limited to)	Introduction, Relevance, Usefulness, Application, Interest, Connection with other courses, Demand in the Industry, Job Prospects etc.
2	Vertical:	**Major**/Minor/Open Electives /Skill Enhancement / Ability Enhancement/Indian Knowledge System
3	Type:	**Practical**
4	Credits:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a Semester)
5	Hours:	**60 Hours**
6	Marks Allotted:	**50 Marks**
7	Course Objective (CO): The students are expected to	
	CO 1.	To study characteristics of sensors, transducers, and display devices.
	CO 2.	To learn op-amp applications in converters, filters, and waveform generators.
	CO 3.	To study signal conditioning using clippers, clampers, and active filters.
	CO 4.	To study analog circuits for measurement and instrumentation systems.
	CO 5.	TO design regulated dual power supplies and constant current sources.
	CO 6.	To Develop practical skills in circuit implementation and testing.
8	Course outcomes (OC): After successful completion of this course, the students will be able to:	
	OC 1.	Applications of sensors and transducers in devices.
	OC 2.	Effective construction of op-amp based analog circuits.
	OC 3.	Verification/ interpretation of experimental circuit parameters.
	OC 4.	Generate and analyze different waveform signals using op-amps.
	OC 5.	Apply laboratory skills for advanced electronics applications.
9	**List of Experiments:** 1. Thermistor as sensor in temperature to voltage converter using OPAMP. 2. Study of LVDT characteristics. 3. Study of Load Cell / Strain Guage. 4. Study of seven segment display. 5. OPAMP D/A Converter: Binary weighted resistors. 6. OPAMP D/A Converter: Ladder network. 7. Positive and Negative Clippers/ Clampers using op-amp. (124/324). 8. Second Order active Low/ High Pass filter (frequency response & phase relation) 9. Study of variable dual power supply using LM 317& LM 337 (± 3v to ± 15v). 10. Constant Current source using OPAMP and PNP transistor (o/p current less than 50 mA). 11. Square and Triangular wave generator using OPAMPs with concept of duty cycle. 12. Basic Instrumentation Amplifier using 3 Op-Amps coupled to resistance bridge. 13. Half wave precision rectifier using precision op-amps. 14. Characteristics of Photo diode and photo transistors. **Minimum 10 experiments from the list of experiments must be completed and reported in the journal.** **General Instructions:** • All the measurements and readings should be written with proper units in SI system only.	

- After completing all the required number of experiments in the semester and recording them in journal, student will have to get their journal certified and produce the certified journal at the time of practical examination to be eligible to appear in the Semester End Practical Examination
- While evaluating practical, weightage should be given to diagram, observations, tabular representation, experimental skills and procedure, graph, calculation and result.
- Skill of doing the experiment and its concepts should be more important than the accuracy of result.

Instruction Regarding Semester End Practical Examination

- For practical examinations, the learner will be examined in **One experiment** from the list of experiments.
- Evaluation in viva voce will be based on regular experiments and skill experiments.
- A candidate will be allowed to appear for the Semester End Practical Examination only if the candidate submit a certified journal at the time of practical examination or provide a certificate from the Head of the Department / Institute to the effect that the candidate has completed the practical course of that semester of T.Y.B. Sc. Physics as per the minimum requirement.

10 **Reference Books:**

1. H & C: Modern Electronic Instrumentation & Measurement Techniques by Albert D. Helfrick & William D. Cooper PHI) Edition.
2. C & D: OPAMPs and linear integrated circuits" by Coughlin & F. F. Driscoll (6th edition PHI)
3. G: OPAMPs and linear integrated circuits by R.A. Gayakwad (4th edition, PHI).
4. M: Electronic Principles by A. P. Malvino, (PHI), 6th edition.
5. K: Electronic Instrumentation by H. S. Kalsi, (TMH) 2nd Edition
6. M & L: Digital Principle and Applications" by Malvino and Leach, (TMH), 5th edition,
7. RPJ: Modern Digital Electronics, R. P. Jain, (TMH), 3rd edition.

11 **Scheme of Examination:**

Semester End Practical Examination:

- The duration of Each Experiment in Semester End External Practical Examination will be of **Two hours.**
- The Semester End External Practical Examination will be for **30** marks as per the marking scheme given below:

Sr. No.	Activity	Total 30 Marks
1	One Experiments	20 Marks
2	Certified Journal	05 Marks
3	Viva	05 Marks

Internal Practical Examination:

- The duration of Internal Practical Examination per experiment will be of **Two hours**.
- The Internal Practical Examination Pattern for **20 marks** (During the Semester), will be as per the marking scheme given below:

Sr. No.	Activity	Total 20 Marks
1	Skill testing related any One Experiment	10 Marks
2	Overall performance	05 Marks
3	Viva-Voce	05 Marks

Elective (ELP - I): Computer Science Practical - I (2 Credits)

Sr. No.	Heading	Particulars
1	Description the course (Including but not limited to)	Introduction, Relevance, Usefulness, Application, Interest, Connection with other courses, Demand in the Industry, Job Prospects etc.
2	Vertical:	**Major**/Minor/Open Electives /Skill Enhancement / Ability Enhancement/Indian Knowledge System
3	Type:	**Practical**
4	Credits:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a Semester)
5	Hours:	**60 Hours**
6	Marks Allotted:	**50 Marks**
7	Course Objective (CO): The students are expected to:	
	CO 1.	apply assembly language programming on 8031/8051/89C51 for arithmetic, logic, and data manipulation.
	CO 2.	demonstrate microcontroller I/O operations by interfacing LEDs and switches with conditional logic control.
	CO 3.	design and implement embedded applications integrating hardware and assembly programming concepts.
	CO 4.	develop Python programs for mathematical, logical, and string/data structure problems using iterative and recursive methods.
	CO 5.	compare low-level microcontroller programming with high-level Python to solve computational and real-world problems.
8	Course outcomes (OC): After successful completion of this course, the students will be able to:	
	OC 1.	apply microcontroller assembly language and Python programming to solve computational and hardware problems.
	OC 2.	analyze and design solutions for arithmetic, logic, and interfacing tasks using LEDs, switches, and ports.
	OC 3.	utilize modern tools and programming techniques to implement and test embedded and software applications.
	OC 4.	work effectively as individuals or in teams, documenting and communicating solutions clearly.
	OC 5.	engage in continuous learning to adapt to evolving technologies in embedded systems and high-level programming.
9	**List of Experiments:** **<u>Experiments for 8031/8051/89C51</u>** 1. 8031/51/89C51 assembly language programming: Simple data manipulation programs. (8/16-bit addition, subtraction, multiplication, 8/16-bit data transfer, cubes of nos., to rotate a 32- bit number, finding greatest/smallest number from a block of data, decimal / hexadecimal counter) 2. Study of IN and OUT port of 8031/51/89C51 by Interfacing switches, and LEDs: Interface 4 LEDs to one of the microcontrollers PORT. Write ALP to display bit pattern on LED's. (i) 1000 0100 0010 0001 continuously (ii) 1100 0110 0011 continuously	

3. Interface 4 switches and 4 LEDs to one of the microcontrollers PORT. Develop various types of logic to control LEDs depending on the status/states/conditions of the 4 switches. For example: Write ALP such that when all four switches are ON all four LEDs should glow. But when any two switches become OFF then all four LEDs should become OFF. And so on……

Python Programming Exercises

1. Assume a suitable value for temperature of a city in Fahrenheit degrees. Write a program to convert this temperature into Centigrade degrees and print both the temperatures.
2. Write a program that swaps the values of two variables using a third variable and without a third variable.
3. Write a program to find the roots of the quadratic equation.
4. Write a program to find if a given number is a prime number.
5. Write a program to find the factorial of a positive integer using looping.
6. Write a program to generate if a three-digit number entered is an Armstrong number or not
7. Write a program to find the GCD and LCM of two positive integers.
8. Write a program that reverses the user defined value and finds the sum of the digits in the reversed number.
9. Write a program to check whether a number is the perfect number or not.
10. Write a program to generate the Fibonacci series.
11. Write a recursive function to print the factorial for a given number.
12. Write a function that takes a character (i.e. a string of length 1) and returns True if it is a vowel, False otherwise.
13. Define a function that computes the length of a given list or string.
14. Write a Python program to check whether the string is Symmetrical or Palindrome.
15. Write a Python Program to Reverse words in a given String.
16. A pangram is a sentence that contains all the letters of the English alphabet at least once, for example: The quick brown fox jumps over the lazy dog. Write a function to check a sentence to see if it is a pangram or not.
17. Write a program that takes two lists and returns True if they have at least one common member.
18. Write a Python program to print a specified list after removing the 0th, 2nd, 4th and 5th elements.
19. Write a Python script to sort (ascending and descending) a dictionary by value.
20. Write a Python script to concatenate two dictionaries to create a new one.
21. Write a Python program to sum all the items in a dictionary

Minimum 10 experiments from the list of experiments must be completed and reported in the journal.

General Instructions:

- All the measurements and readings should be written with proper units in SI system only.
- After completing all the required number of experiments in the semester and recording them in journal, student will have to get their journal certified and produce the certified journal at the time of practical examination to be eligible to appear in the Semester End Practical Examination
- While evaluating practical, weightage should be given to diagram, observations, tabular representation, experimental skills and procedure, graph, calculation and result.
- Skill of doing the experiment and its concepts should be more important than the accuracy of result.

Instruction Regarding Semester End Practical Examination

- For practical examinations, the learner will be examined in **One experiment** from the list of experiments.
- Evaluation in viva voce will be based on regular experiments and skill experiments.
- A candidate will be allowed to appear for the Semester End Practical Examination only if the candidate submit a certified journal at the time of practical examination or provide a certificate from the Head of the Department / Institute to the effect that the candidate has completed the practical course of that semester of T.Y.B. Sc. Physics as per the minimum requirement.

10 **Reference Books:**

1. Programming & customizing the 8051 Microcontroller By Myke Predko, TMH.
2. The 8051 Microcontroller & Embedded Systems by M.A. Mazidi, J.G. Mazidi and R.D.Mckinlay, Second Edition, Pearson
3. Paul Gries, et al., Practical Programming: An Introduction to Computer Science Using Python 3, Pragmatic Bookshelf, 2/E 2014
4. Python Programming for Students: Mahesh Bhave & Sunil Patekar, Shroff Publishers & Distributers Pvt Ltd. First Edition August 2021
5. Starting out with Python, Tony Gaddis, Fourth Edition Pearson
6. Python Programming, Anurag Gupta, G Biswas, 1st Edition McGraw Hill
7. The Complete Reference: Python Martin C Brown, 1st Edition

In addition to the reference books **internet web-sites & MOOC** can be used wherever necessary.

11 **Scheme of Examination:**

Semester End Practical Examination:

- The duration of Each Experiment in Semester End External Practical Examination will be of **Two hours.**
- The Semester End External Practical Examination will be for **30** marks as per the marking scheme given below:

Sr. No.	Activity	Total 30 Marks
1	One Experiments	20 Marks
2	Certified Journal	05 Marks
3	Viva	05 Marks

Internal Practical Examination:

- The duration of Internal Practical Examination per experiment will be of **Two hours**.
- The Internal Practical Examination Pattern for **20 marks** (During the Semester), will be as per the marking scheme given below:

Sr. No.	Activity	Total 20 Marks
1	Skill testing related any One Experiments	10 Marks
2	Overall performance	05 Marks
3	Viva-Voce	05 Marks

Vertical – 4
VSC Practical (2)

VSC: Vocational Skill Course (Credit - 2)
Study of Solar Panel and its installation

Sr. No.	Heading	Particulars
1	Description the course (Including but not limited to)	Introduction, Relevance, Usefulness, Application, Interest, Connection with other courses, Demand in the Industry, Job Prospects etc.
2	Vertical:	Elective
3	Type:	Practical
4	Credits:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a Semester)
5	Hours:	60 Hours
6	Marks Allotted:	50 Marks
7	Course Objective (CO): The students are expected to	
	CO 1	generate awareness among students about Renewable Energy sources and Solar Energy System
	CO 2	develop concept of Working Solar Cell and Solar Photo Voltaic (SPV) Module
	CO 3	understand components of solar photovoltaic system and its parameters
	CO 4	understand I-V characteristics and calculation of power, fill factor and efficiency of solar panel
	CO 5	students understand the room energy audit, installation and interconnections of solar panel
	CO 6	understand the Maintenance and Trouble-shooting of PV Modules
8	Course outcomes (OC): After successful completion of this course, the students will be able to	
	OC 1	students gain the basics of renewable energy sources and solar energy system and its applications.
	OC 2	students comprehend knowledge about solar cell and Solar Photo Voltaic (SPV) Module
	OC 3	students understand basics of components of solar photovoltaic system its parameters.
	OC 4	students comprehend knowledge of installation and interconnection of solar panel.
	OC 5	students understand the maintenance and troubleshooting of PV Modules
9	**List of Experiments** 1. Photovoltaic effect and working of solar cell Aim and Objective: Explain Photovoltaic effect, Construction & Working Solar Cell and Solar Photo Voltaic (SPV) Module 2. Study of solar panel and main components of solar photo voltaic system Aims and objectives: Explain structure of solar panel, types of solar panel and main components solar photovoltaic system 3. Study of Electrical Parameters of Solar Cells: Aims and Objectives: Explain short circuit current, Isc, open circuit voltage Voc, Maximum power current IMP, Maximum power voltage VMP, Maximum power voltage (MPP), Fill Factor, efficiency with I- V characteristics. 4. Study of I–V Characteristics of a Solar Panel Aim and Objective: To plot current vs. voltage (I–V) and power vs. voltage (P–V) characteristics of a photovoltaic panel under different illumination levels and determine open-circuit voltage, short-circuit current, and maximum power point (MPP) and calculate the fill factor and efficiency of a solar panel.	

5. Study of effect of load on output power of a Solar Panel
   Aim and Objective: To measure the current, voltage and calculate power for different resistive loads of the solar panel
6. Effect of Shading on Solar Panel Performance
   Aim and Objective: To study how shading (25 %, 50% etc.) affects on a solar panel current, voltage, and output power.
7. Effect of Different Colour Light on Solar Panel Performance
   Aim and Objective: To study how different coloured lights (red, green, blue) affect the voltage, current, and power output of a solar panel. Compare which light wavelength gives maximum output.
8. Study of series connections of solar panels and the output power
   Aims and objectives: To investigate the electrical behavior (voltage, current, power) of solar panels connected in series and parallel configurations.
9. Study of parallel connections of solar panels and the output power
   Aims and objectives: To investigate the electrical behavior (voltage, current, power) of solar panels connected in series and parallel configurations.
10. Energy Audit
    Aim and Objective: To calculate daily system energy demand using different household appliances
11. Installation of 2 kW solar panel system and load calculation
    Aims and objectives: To determine the number of solar panels required for a 2-kilowatt solar system
12. Interconnections to the solar module (Using a Small PV Panel)
    Aims and objectives: To study the correct polarity and wiring sequence of a solar module and perform the interconnection between the solar panel and charge controller using a small (10–20 W) photovoltaic module.
13. Installation of solar panel
    Aims and objectives: To study the effect of tilt angle and row spacing on solar panel installation using a small indoor model and calculate recommended spacing using site latitude.
14. Maintenance and troubleshooting of PV Modules
    Aim and Objective: Maintenance on solar PV modules, wiring and mounting structures by inspecting for dust, shading, corrosion, loose connections, physical damage, and environmental wear, and ensuring proper cleaning and system health.
15. Fault Diagnosis & Repair (Electrical Troubleshooting)
    Aim and Objective: To diagnose intentionally introduced faults in a PV module system such as open circuits, short circuits, loose connections, reverse polarity, blown fuses, bypass diode failure, and weak cells and to restore normal operation using systematic troubleshooting.

- Minimum **08** experiments from the list of experiments
- All the measurements and readings should be written with proper units in SI system only.
- After completing the required number of experiments in the semester and recording them in journal, student will have to get their journal certified and produce the certified journal at the time of practical examination to be eligible to appear in the Semester End Practical Examination

General Instructions:

- For practical examinations, the learner will be examined in One experiment only.
- Evaluation in viva voce will be based on regular experiments and skill experiments.
- A candidate will be allowed to appear for the semester end practical examination only if the candidate submits a certified journal at the time of practical examination of the semester

<table>
<tr><td></td><td>or a certificate from the Head of the Department / Institute to the effect that the candidate has completed the practical course of that semester of T. Y. B. Sc. Physics as per the minimum requirement.</td></tr>
<tr><td>10</td><td>Reference Books:
1. Solar Electricity Handbook. A Simple, Practical Guide to Solar Energy - Designing and Installing Photovoltaic Solar Electric Systems. Michael Boxwell · 2010. Greenstream Publishing
2. Solar Based Geen Energy Solutions Basics, Sizing & Installation, Dr Dinesh V Kala, Book Media
3. From Sunlight to Electricity: A practical handbook on solar photovoltaic applications (Third Edition), Suneel Deambi.
4. Solar PV System: Design, Installation, Operation and Maintenance, L. Ashok Kumar, K. Mohana Sundaram, Nova Publisher.</td></tr>
<tr><td>11</td><td>Scheme of Examination:
Semester End Practical Examination:
• The duration of Each Experiment in Semester End External Practical Examination will be of Two hours.
• The Semester End External Practical Examination will be for 30 marks as per the marking scheme given below:
<table>
<tr><th>Sr. No.</th><th>Activity</th><th>Total 30 Marks</th></tr>
<tr><td>1</td><td>One Experiment from either Group A or Group B</td><td>20 Marks</td></tr>
<tr><td>2</td><td>Certified Journal</td><td>05 Marks</td></tr>
<tr><td>3</td><td>Viva</td><td>05 Marks</td></tr>
</table>
Internal Practical Examination:
• The duration of Internal Practical Examination per experiment will be of Two hours.
• The Internal Practical Examination Pattern for 20 marks (During the Semester), will be as per the marking scheme given below:
<table>
<tr><th>Sr. No.</th><th>Activity</th><th>Total 20 Marks</th></tr>
<tr><td>1</td><td>Skill testing related any one experiment.</td><td>10 Marks</td></tr>
<tr><td>2</td><td>Overall performance</td><td>05 Marks</td></tr>
<tr><td>3</td><td>Viva-Voce</td><td>05 Marks</td></tr>
</table>
</td></tr>
</table>

SEM. – VI

Vertical – 1 Major Mandatory (2+2+2+2+2+2+2)

Syllabus of Scheme III
T. Y. B. Sc. Physics
(Semester- VI)

Name of the Course: Physics Major Course 10
MJ - 10: Classical Physics (2 Credits)

Sr. No.	Heading			Particulars
1	Description the course (Including but Not limited to)		:	Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc.
2	Vertical		:	**Major**/Minor/Open Electives /Skill Enhancement / Ability Enhancement/Indian Knowledge System
3	Type		:	**Theory**
4	Credits		:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	Hours Allotted		:	30 Hours
6	Marks Allotted		:	50 Marks
7	Course Objectives (CO): The students are expected to:			
	CO 1.	learn different aspects of classical mechanics.		
	CO 2.	understand the kinds of motions that can occur under a central potential and their applications to planetary orbits.		
	CO 3.	learn the moving coordinate system, rectilinear as well as rotating.		
	CO 4.	learn the concepts needed for the important formalism of Lagrange's equations and derive the equations using D'Alembert's principle.		
	CO 5.	learn to solve simple examples using this formalism.		
8	Course Outcomes (OC): After successful completion of the course, the student will be able to			
	OC 1.	demonstrate an understanding of the fundamental concepts and various aspects of classical mechanics		
	OC 2.	apply the principles of rotating and moving co-ordinate systems to explain motion on the rotating Earth, the Foucault pendulum and Larmor's theorem.		
	OC 3.	explain the kinematics and dynamic of ideal fluids and use conservation laws to analyze fluid motion.		
	OC 4.	explain the formalism on Lagrange's equation and derive them using D'Alembert's principle.		
	OC 5.	describe the basic concepts of nonlinear dynamics and chaos, including bifurcation and logistic map		
9	**Modules / Units**: - There will be One Module / Unit Per Credit			
	Module I / Unit I: Central Force Fluid Motion and Rigid body rotation (15 Hours)			
	Motion under a central force, the central force inversely proportional to the square of the distance, Elliptic orbits, The Kepler problem. **KRS:3.13-3.15** Moving origin of coordinates, Rotating coordinate systems, Laws of motion on the rotating earth, The Foucault pendulum, Larmor's theorem.			

	KRS: 7.1-7.5 Kinematics of moving fluids, Equation of motion for an ideal fluid, Conservation laws for fluid motion. **KSR :8.6 to 8.8**		
	Module II / Unit II: Lagrange's equations and Non-Linear Mechanics (15 Hours)		
	D'Alembert's principle, Constraints, Examples of holonomic constraints, examples of nonholonomic constraints, degrees of freedom and generalized coordinates, illustrative problems. Lagrange's equation in one dimension, Lagrange's equation in three dimensions, Lagrange's equations using D'Alembert's principle, Examples, Systems subject to constraints, Constants of motion and ignorable coordinates. **HG:1.4** **PVP: 4.2 to 4.9, 5.2 to 5.4,7.2 ,7.3** **KRS: 9.1 to 9.6** Transition to chaos: Bifurcations and strange attractors, Aspects of chaotic behavior (Logistic map). **BO: 11.4,11.5 A** **GA:12.2, 12.3,12.4**		
10	**Reference Books:** 1. **KRS**: Mechanics: Keith R. Symon (Addison Wesely, 3rd Ed.) 2. **HG**: Classical Mechanics: Herbert Goldstein, (Narosa 2nd Ed.) 3. **BO**: Classical Mechanics- a Modern Perspective: V. D. Barger and M. G. Olsson. (Mc Graw Hill International 1995 Ed.) 4. **PVP**: Classical Mechanics, P. V. Panat (Narosa) ?? 5. **GA**: Classical Mechanics by G.Aruldas PHI Learning Private Limited **Additional Reference Books:** 1. An Introduction to Mechanics: Daniel Kleppner & Robert Kolenkow, Tata Mc Graw Hill (Indian Ed. 2007). 2. Classical Mechanics – System of Particles and Hamiltonian Dynamics: Walter Greiner (Springer). 3. Introduction to Classical Mechanics: P. S. Puranik and R. G. Takwale (Tata McGraw-Hill).		
11	**Internal Continuous Assessment: 40% (20 Marks)**	**External Assessment: (60%) (30 Marks)**	
12	**Continuous Evaluation through:** Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc. (at least 3)	**Evaluation:** through Exam at the End of the Semester / Term.	
13	Format of Question Paper for Semester End Examination Total Marks: **30 Marks** Duration: **One Hour**		
	Module I / Unit-I 15 Marks	Q.1 A) Attempt any Two (Each carry 05 Marks) i) Theory ii) Theory iii) Theory iv) Theory	10 Marks

		Q.1 B) Attempt any One (Each carry 05 Marks) i) Problem / Theory ii) Problem	05 Marks
	Module II / Unit-II 15 Marks	Q.2 A) Attempt any Two (Each carry 05 Marks) i) Theory ii) Theory iii) Theory iv) Theory	10 Marks
		Q.2 B) Attempt any One (Each carry 05 Marks) i) Problem / Theory ii) Problem	05 Marks

Name of the Course: Physics Major Course 11
MJ - 11: Nuclear Physics (2 Credits)

Sr. No.	Heading		Particulars
1	Description the course (Including but Not limited to)	:	Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc.
2	Vertical	:	**Major**/Minor/Open Electives /Skill Enhancement / Ability Enhancement/Indian Knowledge System
3	Type	:	**Theory**
4	Credits	:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	Hours Allotted	:	30 Hours
6	Marks Allotted	:	50 Marks
7	Course Objectives (CO): The students are expected to:		
	CO 1.	describe and analyze various radioactive decay processes, including alpha, beta, and gamma decays, along with their underlying mechanisms and laws of conservation.	
	CO 2.	understand and compare different nuclear models**,** such as the liquid drop model and shell model, to interpret nuclear stability and reactions.	
	CO 3.	discuss the principles, design, and applications of particle accelerators in probing nuclear and subatomic structures.	
	CO 4.	explore the concepts of nuclear energy production**,** including fission and fusion processes, and their technological and societal implications	
	CO 5.	introduce the fundamental ideas of elementary particles and their interactions, providing a bridge between nuclear and particle physics.	
8	Course Outcomes (OC): After successful completion of the course, the student will be able to		
	OC 1.	analyze alpha, beta, and gamma decay processes using appropriate nuclear models and conservation laws.	
	OC 2.	apply the liquid drop model and other nuclear models to interpret nuclear binding energy, stability, and reaction mechanisms.	
	OC 3.	describe the working principles and functions of various particle accelerators and their role in nuclear and particle physics research.	
	OC 4.	evaluate the principles of nuclear fission and fusion to understand the generation and applications of nuclear energy.	
	OC 5.	classify elementary particles and explain their fundamental interactions within the framework of modern particle physics.	
9	**Modules / Units**: - There will be One Module / Unit Per Credit		
	Module I / Unit I: Radioactive decay & Nuclear Models (15 Hours)		
	Unit I (15 Lectures) **1. Radioactive decay processes** **Alpha decay:** Velocity and energy, the absorption of alpha particles: range, ionization and stopping power, Geiger Nuttal law, Disintegration Energy of spontaneous alpha-decay, Gamow's theory of alpha decay IK: 13. 1, 13.2, SBP: 4. II. 1, 4. II. 2, 1.II.3 **Beta decay:** Introduction, velocity and energy of beta particles, Different modes of beta disintegration, Pauli's neutrino hypothesis, Detection of neutrino - Cowan and Reines Experiment(Qualitative) IK: 14.1, SBP: 4. III.1, 4. III.3, 4. III.5,		

	Gamma decay: Introduction SBP: 4. IV. 1 2. **Nuclear Models:** Liquid drop model, Weizsacker's semi-empirical mass formula, Mass parabolas - Prediction of stability against beta decay for members of an isobaric family SBP: 5.1, 5.3, 5.4		
	Module II / Unit II Nuclear Energy, Force and Elementary Particles (15 Hours)		
	1. **Nuclear energy:** Introduction, Energy released in fission of U^{235}, Fission chain reaction, Nuclear reactors(Qualitative) SBP : 6.1, 6.5, 6.7, 6.9 **Particle Accelerators:** Cyclotron and Idea of Large Hadron Collider (Qualitative) SBP: 1.I.4 https://home.cern/science/accelerators/large-hadron-collider 2. **Nuclear force and Elementary particles:** Introduction, Meson theory of Nuclear Force. SBP: 8.1, 8.6 **Elementary particles:** Introduction, Classification of elementary particles, Conservation laws (linear &angular momentum, energy, charge, baryon number & lepton number) DCT: 18.1, 18.2, 18.4		
10	**Reference Books:** 1. SBP: Nuclear Physics, S.B. Patel (New Age International P. Ltd.). 2. IK: Nuclear Physics, Irving Kaplan (2nd Ed.) (Addison Wesley). 3. DCT: Nuclear Physics, D. C. Tayal (Himalayan Publishing House) (5th Ed.) 4. AB: Concepts of Modern Physics: Arthur Beiser, Shobhit Mahajan, S Rai Choudhury (6th Ed.) (TMH). **Additional Reference Books:** 1. SNG: Nuclear Physics, S. N. Ghoshal (S. Chand & Co.) 2. Modern Physics: Kenneth Krane (2nd Ed.), John Wiley & Sons. 3. Atomic & Nuclear Physics: N Subrahmanyam, Brij Lal. (Revised by Jivan Seshan.) S. Chand. 4. Introduction to Elementary Particles: David Griffith, Second Revised Edition, Wiley-VCH.		
11	**Internal Continuous Assessment: 40% (20 Marks)**	**External Assessment: (60%) (30 Marks)**	
12	**Continuous Evaluation through:** Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc. (at least 3)	**Evaluation:** through Exam at the End of the Semester / Term.	
13	Format of Question Paper for Semester End Examination Total Marks: **30 Marks** Duration: **One Hour**		
	Module I / Unit-I 15 Marks	Q.1 A) Attempt any Two (Each carry 05 Marks) i) Theory ii) Theory iii) Theory iv) Theory	10 Marks

		Q.1 B) Attempt any One (Each carry 05 Marks) i) Problem / Theory ii) Problem	05 Marks
	Module II / Unit-II 15 Marks	Q.2 A) Attempt any Two (Each carry 05 Marks) i) Theory ii) Theory iii) Theory iv) Theory	10 Marks
		Q.2 B) Attempt any One (Each carry 05 Marks) i) Problem / Theory ii) Problem	05 Marks

Name of the Course: Physics Major Course 12
MJ - 12: Special Theory of Relativity (2 Credits)

Sr. No.	Heading		Particulars
1	Description the course (Including but Not limited to)	:	Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc.
2	Vertical	:	**Major**/Minor/Open Electives /Skill Enhancement / Ability Enhancement/Indian Knowledge System
3	Type	:	**Theory**
4	Credits	:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	Hours Allotted	:	30 Hours
6	Marks Allotted	:	50 Marks
7	Course Objectives (CO): The students are expected to		
	CO 1.		familiarise with the Michelson-Morely experiment, Lorentz Fitzgerald contraction hypothesis, and ether drag hypotheses.
	CO 2.		understand and apply mathematical formulation of special theory of relativity through Lorentz transformations (space and time, velocity, momentum and energy, electric and magnetic fields), and its consequences (time dilation, length contraction velocity addition)
	CO 3.		introduce and explain the concept of relativistic mass and how it modifies the classical definitions of momentum and force in the context of special relativity.
	CO 4.		learn concept general relativity, equivalence principle, gravitational redshift, blueshift, and pulsars, quasars and blazars.
	CO 5.		apply the concept and solve numerical problems involving length contraction, time dilation, velocity addition, Doppler effect, relativistic mass, energy, momentum, transformations, and astrophysical phenomena.
8	Course Outcomes (OC): After successful completion of the course, the student will be able to		
	OC 1.		explain the significance of Michelson-Morely experiment and limitations of classical mechanics.
	OC 2.		derive and apply Lorentz transformation equations to space, time, velocity, momentum and energy, and electric and magnetic fields
	OC 3.		solve problems based on relativistic consequences such as time dilation, length contraction, Doppler effect, velocity addition, relativistic momentum, and energy
	OC 4.		demonstrate the relationship between mass and energy, analyze relativistic momentum and energy.
	OC 5.		explain the principle of equivalence, general relativity, and phenomena like gravitational redshift.
9	**Modules / Units**: - There will be One Module / Unit Per Credit		
	Module I / Unit I: Relativistic Kinematics (15 Hours)		
	(**Review:** Inertial and Non-inertial frames of reference, invariance of physical quantity, Galilean transformation, Newtonian relativity, Conflict of Newtonian mechanics with electromagnetism.) Michelson-Morely experiment **(omit derivation part);** Lorentz Fitzgerald contraction hypothesis, Ether drag hypothesis (conceptual) ; Postulates of the special theory of relativity, Concept of Simultaneity, Derivation of Lorentz transformation equations, Consequences of the Lorentz transformation equations: Length contraction, Time dilation; The Relativistic		

<table>
<tr><td></td><td colspan="3">addition of velocities and its consequences; Aberration and Doppler effect in relativity; Space –time diagrams, Twin paradox; Application: GPS Technology. Problem based on length contraction, time dilation, velocity addition, Doppler effect

RR 1.5-1.7, 1.9, 2.1-2.3, 2.6-2.7, A1, B1, B2</td></tr>
<tr><td></td><td colspan="3">Module II / Unit II: Relativistic Dynamics and Electromagnetism (15 Hours)</td></tr>
<tr><td></td><td colspan="3">(Review: Newton’s law of motion and momentum conservation, Energy conservation in classical mechanics, Basic of electric and magnetic fields.)
Concept of relativistic mass (omit derivation), Relativistic definition of momentum and force; Relativistic force law and the dynamics of a single particle (Derivation $E=mc^2$, momentum and energy relation, longitudinal and transverse mass) ; The transformation properties of momentum, energy, mass; The transformation equation force (omit derivation); The interdependence of Electric and Magnetic fields, The transformation for E and B; The field of a uniformly moving point charge; The principle of equivalence and brief introduction to general relativity; Gravitational red shift, blue shift, pulsars, quasars ,blazars, Problem based on all above topics.

RR 3.2-3.3, 3.5, 3.7, 4.2 -4.4, C2, C3</td></tr>
<tr><td>10</td><td colspan="3">Reference Books:
1. RR: Introduction to Special Relativity Wiley India Pvt. Ltd. by Robert Resnick (Student Edition)

Additional Reference Books:
1. The Special Theory of Relativity PHI PVT Ltd by Srirajan Banarji & Asit Banerjee
2. A Prime of Special Relativity New Age International Publisher by P. L. Sardesai.
3. Special theory of Relativity CRC Press by A. P. French.
4. Concepts of Modern Physics 6th Edition McGraw Hill by Arthur Beiser.</td></tr>
<tr><td>11</td><td colspan="2">Internal Continuous Assessment: 40% (20 Marks)</td><td>External Assessment, (60%)
(30 Marks)</td></tr>
<tr><td>12</td><td colspan="2">Continuous Evaluation through: Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc. (at least 3)</td><td>Evaluation: through Exam at the End of the Semester / Term.</td></tr>
<tr><td>13</td><td colspan="3">Format of Question Paper for Semester End Examination
Total Marks: 30 Marks Duration: One Hour</td></tr>
<tr><td></td><td>Module I / Unit-I
15 Marks</td><td>Q.1 A) Attempt any Two (Each carry 05 Marks)
i) Theory
ii) Theory
iii) Theory
iv) Theory</td><td>10 Marks</td></tr>
<tr><td></td><td></td><td>Q.1 B) Attempt any One (Each carry 05 Marks)
i) Problem /Theory
ii) Problem</td><td>05 Marks</td></tr>
<tr><td></td><td>Module II / Unit-II
15 Marks</td><td>Q.2 A) Attempt any Two (Each carry 05 Marks)
i) Theory
ii) Theory
iii) Theory
iv) Theory</td><td>10 Marks</td></tr>
<tr><td></td><td></td><td>Q.2 B) Attempt any One (Each carry 05 Marks)
i) Problem / Theory
ii) Problem</td><td>05 Marks</td></tr>
</table>

Name of the Course: Physics Major Course 13
MJ - 13: Electronics (2 Credits)

Sr. No.	Heading		Particulars
1	Description the course (Including but Not limited to)	:	Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc.
2	Vertical	:	**Major**/Minor/Open Electives /Skill Enhancement / Ability Enhancement/Indian Knowledge System
3	Type	:	**Theory**
4	Credits	:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	Hours Allotted	:	30 Hours
6	Marks Allotted	:	50 Marks
7	Course Objectives (CO): The students are expected to		
	CO 1.		explain basics of semiconductor devices JFET, MOSFET, SCR and UJT, its characteristics, biasing, specification parameters and its applications.
	CO 2.		understand basics of OP-AMP, its different parameters and applications.
	CO 3.		understand basics concepts of transistor multivibrators, timing pulse generation 555 timer and its applications.
	CO 4.		explain regulated power supplies its characteristics and its types.
	CO 5.		demonstrate quantitative problem-solving skills in all the topics covered.
8	Course Outcomes (OC): After successful completion of this course, the students will be able to		
	OC 1.		gain the basic knowledge of semiconductor devices and its applications.
	OC 2.		comprehend knowledge about JFET, MOSFET, SCR and UJT its Biasing, parameters and its applications.
	OC 3.		understand basics of OPAMP, its parameters and its applications.
	OC 4.		comprehend knowledge of transistorized multivibrators, multivibrators using 555 timer and its applications.
	OC 5.		acquire a fundamental understanding of regulated power supply, shunt and series regulator.
9	**Modules / Units**: - There will be One Module / Unit Per Credit		
	Module I / Unit I: Transistors and SCR (15 Hours)		
	1. Field Effect Transistor: Introduction of JFET, Advantages and disadvantages of JFET over BJT, Classification of FET , Construction of n-channel and p- channel JFET, Biasing of JFET: biasing in ohmic region (Gate bias), biasing in active region (self-bias), Operation of n-channel JFET, JFET characteristics: Drain characteristics (output characteristics), Transfer characteristics, parameters of JFET (dynamic resistance(r_d), Transconductance (g_m) and amplification factor) , Applications of JFET, JFET as common source amplifier , JFET as analog Switch, JFET as voltage variable resistor (VVR). **MB: 11.1 to 11.9** 2. MOSFET: Circuit symbol and construction of n-channel and p-channel MOSFET, Principle of operation and characteristics of n–channel Depletion and Enhancement mode MOSFET, digital switching (Analog, Digital and Switching circuits).		

	MB: 12.1, 12.2, 12.4, 12.6 3. SCR: Construction (structure & circuit symbol), operation of SCR, firing and Gate triggering of SCR, characteristics of SCR, specification parameters of SCR. AM: 28.1 4. UJT: Circuit symbol & construction of UJT, operating principle, characteristics of UJT, specification parameters of UJT and relaxation oscillator. AM: 28.5	
	Module II / Unit II: Amplifiers, Multivibrators and Power Supplies (15 Hours)	
	1. Differential amplifier using transistor the differential amplifier DC and AC analysis of a differential amplifier, Op-AMP applications: log amplifier, instrumentation amplifier, square and triangular wave generator using OP-AMP and Wien-Bridge oscillator using OP-AMP. **MB: 15.1 to 15.5** **KVR: 13.3.1, 13.4.2, 14.3.4.2, 14.5.2.2, 14.5.3** 2. Transistor multivibrator: Astable, Monostable and Bistable multivibrators **AM: 18.11** 3. 555 Timer: Functional block diagram, Monostable and Astable operation, Application of 555 timer: voltage-controlled oscillator, pulse width moderator and pulse position modulator **MB: 21.7, 21.8, 21.9.5** 4. Regulated Power supplies: supply characteristics, Voltage regulator parameter, Basic configurations of voltage regulator, Shunt and series regulators, short circuit protection. **MB: 22.1, 22.2, 22.3, 22.4, 22.5**	
10	**Reference Books:** 1. MB: Electronic Principles, Malvino & Bates -7th Edition TMH Publication. 2. AM: Electronic Devices and Circuits, Allen Mottershead -PHI Publication. 3. KVR: Functional Electronics, K.V. Ramanan-TMH Publication **Additional Reference Books:** 1. RYB: Basics Electronic Devices and Circuits – R. Y. Borse 2. VKM: Principles of Electronics: V.K. Mehta & Rohit Mehta, Multicolour Illustrative Edition, S. Chand & Company 3. ML: Digital Principles and Applications, Malvino and Leach (4^{th} Edition) (TMH).	
11	**Internal Continuous Assessment: 40%** (20 Marks)	**External Assessment, (60%)** **(30 Marks)**
12	**Continuous Evaluation through:** Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc. (at least 3)	**Evaluation:** through Exam at the End of the Semester / Term.
13	Format of Question Paper for Semester End Examination Total Marks: **30 Marks** Duration: **One Hour**	

	Module I / Unit-I 15 Marks	Q.1 A) Attempt any Two (Each carry 05 Marks) i) Theory ii) Theory iii) Theory iv) Theory	10 Marks
		Q.1 B) Attempt any One (Each carry 0 Marks) i) Problem /Theory ii) Problem	05 Marks
	Module II / Unit-II 15 Marks	Q.2 A) Attempt any Two (Each carry -5 Marks) i) Theory ii) Theory iii) Theory iv) Theory	10 Marks
		Q.2 B) Attempt any One (Each carry 05 Marks) i) Problem / Theory ii) Problem	05 Marks

Name of the Course: T. Y. B. Sc. Physics Major Course 14
MJ - 14: Atomic and Molecular Physics (2 Credits)

Sr. No.	Heading			Particulars
1	Description the course (Including but Not limited to)		:	Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc.
2	Vertical		:	**Major**/Minor/Open Electives /Skill Enhancement / Ability Enhancement/Indian Knowledge System
3	Type		:	**Theory**
4	Credits		:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	Hours Allotted		:	30 Hours
6	Marks Allotted		:	50 Marks
7	Course Objectives (CO): The students are expected to			
	CO 1.	develop a clear understanding of the structure of atoms and molecules, including one- electron and multi- electron systems, and the quantum mechanical basis of their behavior.		
	CO 2.	understand how atoms and molecules interact with external static and dynamic fields (electric, magnetic) and the consequences such as Zeeman effect for atomic and molecular spectra.		
	CO 3.	learn the theory and apply the methods of atomic and molecular spectroscopy (discrete energy levels, rotational, vibrational, electronic transitions, molecular spectra) to analyze them.		
	CO 4.	develop problem-solving skills in applying quantum mechanical tools to atomic and molecular systems		
	CO 5.	Bridge theory with applications: relate the principles of atomic & molecular physics to practical experiments and modern technologies		
8	Course Outcomes (OC): After successful completion of this course, the students will be able to			
	OC 1.	explain the quantum mechanical model of atoms, the origin of quantized energy levels, and the significance of quantum numbers.		
	OC 2.	describe the effects of external fields (Zeeman effect) on atomic spectra.		
	OC 3.	apply vector model of atom and coupling schemes (LS and jj coupling) to determine the total angular momentum and term symbols of atomic states.		
	OC 4.	interpret rotational, vibrational, and electronic spectra of diatomic molecules		
	OC 5.	develop problem-solving skills in applying approximation methods to atomic and molecular systems.		
9	**Modules / Units**: - There will be One Module / Unit Per Credit			
	Module I / Unit I: Hydrogen Atom and Spin Orbit Coupling (15 Hours)			

<table>
<tr><td></td><td colspan="3">Unit I (15 periods)
1. Hydrogen atom: Schrödinger’s equation for Hydrogen atom, Separation of variables, Quantum Numbers, Angular momentum, Stern Gerlach Experiment (Review), Pauli Exclusion principle, Symmetric and Anti-symmetric wave functions
B: 9.1, 9.2, 9.3, 9.8, 10.1, 10.3

2. Spin orbit coupling, Total angular momentum, Vector atom model: L-S and j-j coupling, the normal Zeeman effect, Quantum theory of Zeeman Effect, Anomalous Zeeman effect, The Lande g – factor (Review)
B: 10.2, 10.7, 10.8, 10.9,
SA: 9.14, 9.15, 9.16, 9.17

Unit II (15 periods)
1. Molecular spectra (Diatomic Molecules): Rotational energy levels, Rotational spectra, Vibrational energy levels, Vibrational spectra, Electronic Spectra & the Franck Condon principle
Infrared spectrometer
B: 14.1, 14.3, 14.5, 14.8
GA: 7.16

2. Raman effect: Quantum Theory of Raman effect, Pure Rotational Raman spectra of linear molecules, Raman activity of vibrations, Experimental set up of Raman Effect
BM: 4.1, 4.1.1, 4.2.1, 4.3.1
GA: 8.6</td></tr>
<tr><td>10</td><td colspan="3">Reference Books:
1. B: Perspectives of Modern Physics: Arthur Beiser (McGraw Hill)
2. SA: Introduction to Atomic & Nuclear Physics: H. Semat & J. R. Albright (5th Ed.) Chapman & Hall
3. GA: Molecular structure and spectroscopy: G Aruldhas (2nd Ed) PHI learning Pvt Ltd.
4. BM: Fundamentals of Molecular Spectroscopy: C. N. Banwell & E. M. McCash (TMH) (4th Ed.)

Additional References Books:
1. Atomic Physics (Modern Physics): S. N. Ghoshal. S. Chand Publication</td></tr>
<tr><td>11</td><td colspan="2">Internal Continuous Assessment: 40%
(20 Marks)</td><td>External Assessment, (60%)
(30 Marks)</td></tr>
<tr><td>12</td><td colspan="2">Continuous Evaluation through: Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc. (at least 3)</td><td>Evaluation: through Exam at the End of the Semester / Term.</td></tr>
<tr><td>13</td><td colspan="3">Format of Question Paper for Semester End Examination
Total Marks: 30 Marks Duration: One Hour</td></tr>
<tr><td></td><td>Module I / Unit-I
15 Marks</td><td>Q.1 A) Attempt any Two (Each carry 05 Marks)
i) Theory
ii) Theory
iii) Theory
iv) Theory</td><td>10 Marks</td></tr>
</table>

		Q.1 B) Attempt any One (Each Carry 05 Marks) i) Problem / Theory ii) Problem	05 Marks
	Module II / Unit-II 15 Marks	Q.2 A) Attempt any Two (Each carry 05 Marks) i) Theory ii) Theory iii) Theory iv) Theory	10 Marks
		Q.2 B) Attempt any One (Each Carry Marks) i) Problem / Theory ii) Problem	05 Marks

SEMESTER VI
Physics Major Practical Course (MJP -VII)

Sr. No.	Heading	Particulars
1	Description the course (Including but not limited to)	Introduction, Relevance, Usefulness, Application, Interest, Connection with other courses, Demand in the Industry, Job Prospects etc.
2	Vertical:	**Major**/Minor/Open Electives /Skill Enhancement / Ability Enhancement/Indian Knowledge System
3	Type:	**Practical**
4	Credits:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a Semester)
5	Hours:	**60** Hours
6	Marks Allotted:	**50** Marks
7	Course Objective (CO): The students are expected to	
	CO 1	learn the skills while performing experiments.
	CO 2	know how to use the apparatus without fear & hesitation.
	CO 3	learn the concepts of physics theory concepts and their practical application
	CO 4	learn the errors and their estimation.
8	Course outcomes (OC): After successful completion of this course, the students will be able to:	
	OC 1	understand & practice the skills while performing experiments.
	OC 2	understand the use of apparatus and their use without fear & hesitation.
	OC 3	correlate the physics theory concepts to practical application.
	OC 4	understand the concept of errors and their estimation.
9	**List of Experiments:** 1. Surface tension of mercury by Quincke's method 2. Thermal conductivity by Lee's method 3. Lloyd's single mirror: determination of wavelength 4. Determination of Planck's Constant by using Photo electric cell 5. To determine the coefficient of Thermal Conductivity of Cu by Searle's Method. 6. JFET as switch (series and shunt) 7. JFET as a common source amplifier 8. Study of JFET characteristics 9. UJT characteristics 10. SCR characteristics 11. To determine the wavelength of Laser using Plane Diffraction Grating. 12. Capacitance by using parallel bridge. **List of Demonstration Experiments:** 1. Open CRO, Power Supply, and Signal Generator: Discuss block diagram. 2. Data sheet reading for diodes, Transistor, Op amp and Optoelectronic devices. 3. Circuit designing – single stage amplifier, Transistor Multivibrator etc. and testing on breadboard 4. Use of LCR meter 5. Constant deviation spectrometer (CDS) 6. Transformer (theory, construction and working), types of transformers and energy losses associated with them. 7. Study of Advance Instrumentation amplifier using IC (Except 741) **Note**: Teacher should follow the above guidelines to conduct Demonstration experiment.	

Minimum 8 experiments from the list of experiments and minimum 4 demonstration experiments must be completed and reported in the journal.

Exemption: Exemption of two experiments may be given, if student carries out any one or more than one of the following activities:

- If the student collects & reports the information of at least five Physicists with their work or any three events on physics, in the journal.
- If the student executes a mini project to the satisfaction of teacher in-charge of practical.
- If the student participates in a study tour or visit & submit a study tour report.

General Instructions:

- All the measurements and readings should be written with proper units in SI system only.
- After completing all the required number of experiments in the semester and recording them in journal, student will have to get their journal certified and produce the certified journal at the time of practical examination to be eligible to appear in the Semester End Practical Examination
- While evaluating practical, weightage should be given to diagram, observations, tabular representation, experimental skills and procedure, graph, calculation and result.
- Skill of doing the experiment and its concepts should be more important than the accuracy of result.

Instruction Regarding Semester End Practical Examination

- For practical examinations, the learner will be examined in **One experiment** from the list of experiments.
- Evaluation in viva voce will be based on regular experiments and demonstration experiments.
- A candidate will be allowed to appear for the Semester End Practical Examination only if the candidate submit a certified journal at the time of practical examination or provide a certificate from the Head of the Department / Institute to the effect that the candidate has completed the practical course of that semester of T.Y.B. Sc. Physics as per the minimum requirement.

10 **Reference Books:**

1. An Advanced course in Practical Physics by D. Chattopadhyay, P. C. Rakshit & B. Saha (8th Edition) Book & Allied Pvt. Ltd.
2. BSc Practical Physics: Harnam Singh. S. Chand & Co. Ltd. – 2001.
3. A Text book of Practical Physics: Samir Kumar Ghosh New Central Book Agency (4th edition).
4. B Sc. Practical Physics: C. L. Arora (1st Edition) – 2001 S. Chand & Co. Ltd
5. Practical Physics: C. L. Squires – (3rd Edition) Cambridge University Press
6. University Practical Physics: D C Tayal. Himalaya Publication.
7. Advanced Practical Physics: Worsnop & Flint.

11 **Scheme of Examination:**

Semester End Practical Examination:

- The duration of Each Experiment in Semester End External Practical Examination will be of **Two hours.**
- The Semester End External Practical Examination will be for **30 marks** as per the marking scheme given below:

Sr. No.	Activity	Total 30 Marks
1	One Experiments	20 Marks
2	Certified Journal	05 Marks

	3	Viva	05 Marks
	Internal Practical Examination: • The duration of Internal Practical Examination per experiment will be of **Two hrs**. • The Internal Practical Examination Pattern for **20 marks** (During the Semester), will be as per the marking scheme given below:		
	Sr. No.	**Activity**	**Total 20 Marks**
	1	Skill testing related any One Experiments	10 Marks
	2	Overall performance	05 Marks
	3	Viva-Voce	05 Marks

SEMESTER VI
Physics Major Practical Course (MJP -VIII)

Sr. No.	Heading	Particulars
1	Description the course (Including but not limited to)	Introduction, Relevance, Usefulness, Application, Interest, Connection with other courses, Demand in the Industry, Job Prospects etc.
2	Vertical:	**Major**/Minor/Open Electives /Skill Enhancement / Ability Enhancement/Indian Knowledge System
3	Type:	**Practical**
4	Credits:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a Semester)
5	Hours:	**60 Hours**
6	Marks Allotted:	**50 Marks**
7	Course Objective (CO): The students are expected to	
	CO 1	develop a strong experimental foundation by performing practical's
	CO 2	understand the theoretical principles behind each experiment and relate them to real-world applications.
	CO 3	learn accurate data recording, tabulation, graphical representation, and scientific reporting.
	CO 4	cultivate a scientific attitude, precision, and safety consciousness while working in a laboratory environment
8	Course outcomes (OC): After successful completion of this course, the students will be able to:	
	OC 1	perform physics experiments independently using standard laboratory equipment and techniques.
	OC 2	prepare clear, accurate laboratory reports and present experimental findings effectively.
	OC 3	demonstrate improved laboratory skills such as instrument handling, calibration, troubleshooting, and safe working practices.
	OC 4	apply experimental knowledge to real-life physical systems and further scientific investigations.
9	**List of Experiments** 1. Self-inductance by Anderson's bridge 2. Mutual Inductance by B.G 3. Op-Amp Instrumentation amplifier 4. OPAMP as monostable / astable using breadboard 5. Schmitt Trigger using OP – AMP 6. Application of IC 555 as a voltage to frequency converter 7. 555 Timer as monostable Multivibrator & Voltage to Time Converter. 8. Design and study of transistorized monostable multivibrator 9. LM-317 as Current regulator 10. UJT as a Relaxation Oscillator 11. Study of Pulse width modulation 12. Study of Pulse position modulation **List of Demonstration Experiments:** 1. Michelson interferometer 2. □h/e vacuum photocell	

	3. Study of Hall effect using IC 4. Digital storage Oscilloscope (DSO) 5. Lux meter/ Flux meter 6. Absorption spectrum of specific liquids 7. Magnetic susceptibility 8. Study of diffraction using CD/DVD **Note**: Teacher should follow the above guidelines to conduct Demo experiment **Minimum 8 experiments from the list of experiments and minimum 4 demonstration experiments must be completed and reported in the journal.** **Exemption:** Exemption of two experiments may be given, if student carries out any one or more than one of the following activities: • If the student collects & reports the information of at least five Physicists with their work or any three events on physics, in the journal. • If the student executes a mini project to the satisfaction of teacher in-charge of practical. • If the student participates in a study tour or visit & submit a study tour report. **General Instructions:** • All the measurements and readings should be written with proper units in SI system only. • After completing all the required number of experiments in the semester and recording them in journal, student will have to get their journal certified and produce the certified journal at the time of practical examination to be eligible to appear in the Semester End Practical Examination • While evaluating practical, weightage should be given to diagram, observations, tabular representation, experimental skills and procedure, graph, calculation and result. • Skill of doing the experiment and its concepts should be more important than the accuracy of result. **Instruction Regarding Semester End Practical Examination** • For practical examinations, the learner will be examined in **One experiment** from the list of experiments. • Evaluation in viva voce will be based on regular experiments and demonstration experiments. • A candidate will be allowed to appear for the Semester End Practical Examination only if the candidate submit a certified journal at the time of practical examination or provide a certificate from the Head of the Department / Institute to the effect that the candidate has completed the practical course of that semester of T.Y.B. Sc. Physics as per the minimum requirement.
10	**Reference Books:** 1. An Advanced course in Practical Physics by D. Chattopadhyay, P. C. Rakshit & B. Saha (8th Edition) Book & Allied Pvt. Ltd. 2. BSc Practical Physics: Harnam Singh. S. Chand & Co. Ltd. – 2001. 3. A Text book of Practical Physics: Samir Kumar Ghosh New Central Book Agency (4th edition). 4. B Sc. Practical Physics: C. L. Arora (1st Edition) – 2001 S. Chand & Co. Ltd 5. Practical Physics: C. L. Squires – (3rd Edition) Cambridge University Press 6. University Practical Physics: D C Tayal. Himalaya Publication. 7. Advanced Practical Physics: Worsnop & Flint.
11	**Scheme of Examination:**

Semester End Practical Examination:

- The duration of Each Experiment in Semester End External Practical Examination will be of **Two hours.**
- The Semester End External Practical Examination will be for **30** marks as per the marking scheme given below:

Sr. No.	Activity	Total 30 Marks
1	One Experiments	20 Marks
2	Certified Journal	05 Marks
3	Viva	05 Marks

Internal Practical Examination:

- The duration of Internal Practical Examination per experiment will be of **Two hours**.
- The Internal Practical Examination Pattern for 40 marks (During the Semester), will be as per the marking scheme given below:

Sr. No.	Activity	Total 20 Marks
1	Skill testing related any One Experiment	10 Marks
2	Overall performance	05 Marks
3	Viva-Voce	05 Marks

Vertical – 1
Electives
(2+2)

Name of the Course: Elective (EL – II): Electronic Instrumentation - II (2 Credits)

Sr. No.	Heading		Particulars
1	Description the course (Including but Not limited to)	:	Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc.
2	Vertical	:	**Major**/Minor/Open Electives /Skill Enhancement / Ability Enhancement/Indian Knowledge System
3	Type	:	**Theory**
4	Credits	:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	Hours Allotted	:	30 Hours
6	Marks Allotted	:	50 Marks
7	Course Objectives (CO): The students are expected to:		
	CO 1.	analyze/design and implement combinational logic circuits.	
	CO 2.	develop assembly language programing skills and real time applications of microprocessor.	
	CO 3.	understand architecture, silent features, instruction set, and programming of 8085 microprocessor.	
	CO 4.	develop the programming skills in C++ language.	
	CO 5.	understand techniques of debugging the C++ programs.	
8	Course Outcomes (OC): After successful completion of the course, the student will be able to		
	OC 1.	Apply the knowledge of Boolean algebra and Karnaugh maps to design simple combinational logic circuits such as multiplexers, decoders, and encoders.	
	OC 2.	excel in programming of 8085 microprocessor and its applications.	
	OC 3.	apply object-oriented programming concepts in C++ for problem solving.	
	OC 4.	develop C++ programs using variables, control structures, functions, and operators.	
	OC 5.	enhance practical knowledge through laboratory experiments.	
	OC 6.	relate theoretical knowledge to practical applications in digital electronics and computing.	
9	**Module / Units**: - There will be One Module / Unit Per Credit		
	Module I / Unit I: Digital Electronics (15 Hours)		
	Combinational Logic Design: Introduction, Boolean identities, K – map (2, 3 and 4 variable). Design and implementations of: Decoders, Encoders, Multiplexers, De-multiplexers, Use of MUX and DEMUX in Combinational Logic design. Code Converters (based on – binary, BCD, Gray and Excess – 3 codes). Tri-State logic, buffers, D latch. 8085 Microprocessor: Introduction, Features of Inter 8085, Pin Diagram of 8085, 8085 CPU Architecture, Arithmetic and Logical Group (ALU, Accumulator, Temporary Register, Flag Register (PSW)), Register Group (Temporary Registers (W and Z), General purpose registers, Special Purpose registers). 8085 Instruction Set:		

	Introduction, Flowchart, Classification of Instruction Set (Data Transfer Group, Arithmetic Group, Logical Group, Branching Group, Stack and Machine Control Group), Notations used in Instructions and Opcode, Data Transfer Group, Program Examples for Data Transfer Group, Arithmetic Operation Group, Branch Group, Logical Group, Addressing Modes, 8085 Programmers Model.
	Unit II: Basic Concepts of Object-Oriented Programming and C++ (15 Hours)
	Basics of Object-Oriented Programming & Beginning with C++: Basic concepts of Object Oriented Programming, Benefits of OOP, Object-Oriented Languages, Applications of OOP. What is C++? Applications of C++, A simple C++ program, More C++ Statements, Example with Class, Structure of C++ Program, Creating the Source File, Compiling and Linking. **EB: 1.5, 1.6, 1.7 & 1.8, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7 & 2.8** **Tokens and Expressions in C++:** Introduction, Tokens, Keywords, Identifiers and Constants, Basic Data Types, User-Defined Data Types, Derived Data Types, Symbolic Constants, Type, Compatibility, Declaration of Variables, Dynamic Initialization of Variables, Reference Variables, Operators in C++, Scope Resolution Operator, Member Dereferencing Operators, Memory Management Operators, Manipulators, Type Cast Operator, Expressions and Their Types, Special Assignment Expressions, Implicit Conversions, Operator Overloading, Operator Precedence. **EB: 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, 3.11, 3.12, 3.13, 3.14, 3.15, 3.16, 3.17, 3.18, 3.19, 3.20, 3.21, 3.22 & 3.23** **Control Structures and Functions:** Control Structures, Functions: The Main Function, Function Prototyping, Call by Reference, Return by Reference, Inline Functions, Default Arguments, Constant Arguments, Function Overloading, Math Library Functions. **EB: 3.24, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9 & 4.11**
10	**Reference Books:** 1. R. P. Jain, Modern Digital Electronics, Tata McGraw Hill, 4th Edition. 2. Digital principles and applications: A.P. Malvino and D. P. Leach. Tata McGraw-Hill. 3. RG: Microprocessor Architecture, Programming and Applications with the 8085, Ramesh Gaonkar, 5th Edition. 4. EB: Object Oriented Programming with C++ by E Balagurusamy, Third / Fourth Edition, Tata McGraw-Hill Publishing Company Limited. **Additional Reference Books:** 1. Microprocessor and Applications by Vibhute and Borole, Techmax Publications. 2. Microprocessor, Principles & Applications by Gilmore (2nd Ed) TMH. 3. Programming with C++ by D. Ravichandran, Tata McGraw-Hill Publishing Company Limited. 4. Starting out with C++ by Tony Gaddis, Third Edition, Addison Wesley Publishing Company. 5. Digital Electronics - by A.P Godse & D.A Godse Technical publications, Pune, Revised third edition, 2008. Pg. No:2.25-2.70 (for K-maps).

<table>
<tr><td>11</td><td colspan="2">Internal Continuous Assessment: 40% (20 Marks)</td><td>External Assessment: (60%) (30 Marks)</td></tr>
<tr><td>12</td><td colspan="2">Continuous Evaluation through: Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc. (at least 3)</td><td>Evaluation: through Exam at the End of the Semester / Term.</td></tr>
<tr><td rowspan="5">13</td><td colspan="3">Format of Question Paper for Semester End Examination
Total Marks: 30 Marks Duration: One Hour</td></tr>
<tr><td rowspan="2">Module I / Unit-I
15 Marks</td><td>Q.1 A) Attempt any Two (Each carry 05 Marks)
i) Theory
ii) Theory
iii) Theory
iv) Theory</td><td>10 Marks</td></tr>
<tr><td>Q.1 B) Attempt any One (Each carry 05 Marks)
i) Problem /Theory
ii) Problem</td><td>05 Marks</td></tr>
<tr><td rowspan="2">Module II / Unit-II
15 Marks</td><td>Q.2 A) Attempt any Two (Each carry 05 Marks)
i) Theory
ii) Theory
iii) Theory
iv) Theory</td><td>10 Marks</td></tr>
<tr><td>Q.2 B) Attempt any One (Each carry 05 Marks)
i) Problem / Theory
ii) Problem</td><td>05 Marks</td></tr>
</table>

Name of the Course: Elective (EL - II): Computer Science - II (2 Credits)

Sr. No.	Heading			Particulars
1	Description the course (Including but Not limited to)		:	Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc.
2	Vertical		:	**Major**/Minor/Open Electives /Skill Enhancement / Ability Enhancement/Indian Knowledge System
3	Type		:	**Theory**
4	Credits		:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	Hours Allotted		:	30 Hours
6	Marks Allotted		:	50 Marks
7	Course Objectives (CO): The students are expected to:			
	CO 1.	study the architecture and functional features of the **8051 microcontrollers**, with emphasis on timers, counters, serial communication, and interrupt systems.		
	CO 2.	develop programming skills in **8051 assembly language** for interfacing external devices and handling real-time events using timers and interrupts.		
	CO 3.	study **object-oriented programming concepts in Python**, including classes, objects, inheritance and also concepts on exception handling and file handling.		
	CO 4.	develop students' ability to perform **numerical computations and array-based processing** using the NumPy library.		
	CO 5.	get familiarized with **data analysis and visualization techniques** using Pandas and Matplotlib for real-world problem solving.		
8	Course Outcomes (OC): After successful completion of the course, the student will be able to			
	OC 1.	**program and configure 8051 timers, counters, serial ports, and interrupts** to implement embedded system applications.		
	OC 2.	**interface the 8051 Microcontroller with external hardware** such as RS-232 devices and develop interrupt-driven embedded programs.		
	OC 3.	**design and implement Python programs using object-oriented principles**, including inheritance. Also, programs based on exception handling and file operations will be performed.		
	OC 4.	**perform numerical and statistical operations on datasets** using NumPy and Pandas data structures.		
	OC 5.	**visualize and interpret data effectively** using Matplotlib to support data-driven decision making.		
9	**Modules / Units**: - There will be One Module / Unit Per Credit			
	Module I / Unit I: Microcontroller **(15 Hours)**			
	8051 Microcontroller: Timer/Counters, Serial Communication, Interrupts Programming 8051 Timers, Counter Programming, Basics of Serial Communication, 8051 Connection to RS232, 8051 Serial Port Programming in assembly, 8051 Interrupts, Programming Timer Interrupts, Programming External Hardware Interrupts **MMM - Ch 9: 9.1, 9.2, 10.1, 10.2, 10.3, 11.1, 11.2, 11.3**			
	Module II / Unit II: **(15 Hours)**			

<table>
<tr><td></td><td colspan="3">Classes and Objects: class and objects, User defined class, Access convention, Object Initialization, class variables, and methods.
Containership and Inheritance: Resuse mechanism, Containership, Inheritance, Features of inheritance, Types of inheritance.
Exception Handling: Syntax Errors, Exceptions, How to deal with Exceptions, try an except block, User defined exceptions, else block, finally block
File Input /Output: I/O System, File I/O, Read /Write operations, File opening modes, moving within a file, Working with CSV files.
NumPy Library: Creation of an array, Array attributes, Array operations, Arithmetic operations, Statistical operations, Indexing and slicing, Array manipulation.
Matplotlib: Installation and usage, plotting graphs, Using objects to plot graphs, Multiple plots, Data visualization.
Pandas Library: Data structures, Creating series, Properties of Series, Accessing Series data, Series Methods, Creating Data Frame, Properties of Data Frame, Accessing Data Frame Data, Data Frame Methods.

Yashavant Kanetkar, Chapter 30</td></tr>
<tr><td>10</td><td colspan="3">Reference Books:
1. MMM - The 8051 Microcontroller & Embedded Systems by M.A. Mazidi, J.G. Mazidi and R.D.Mckinlay, Second Edition, Pearson
2. Intel’s 8031/8051 Data sheet
3. Yashavant Kanetkar, Aditya Kanetkar: Let Us Python, 7th Edition
4. In addition to the reference books internet web-sites & MOOC can be used wherever necessary.</td></tr>
<tr><td>11</td><td colspan="2">Internal Continuous Assessment: 40% (20 Marks)</td><td>External Assessment: (60%) (30 Marks)</td></tr>
<tr><td>12</td><td colspan="2">Continuous Evaluation through: Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc. (at least 3)</td><td>Evaluation: through Exam at the End of the Semester / Term.</td></tr>
<tr><td>13</td><td colspan="3">Format of Question Paper for Semester End Examination
Total Marks: 30 Marks Duration: One Hour</td></tr>
<tr><td></td><td>Module I / Unit-I 15 Marks</td><td>Q.1 A) Attempt any Two (Each carry 05 Marks)
i) Theory
ii) Theory
iii) Theory
iv) Theory</td><td>10 Marks</td></tr>
<tr><td></td><td></td><td>Q.1 B) Attempt any One (Each carry 05 Marks)
(i) Problem /Theory
(ii) Problem</td><td>05 Marks</td></tr>
<tr><td></td><td>Module II / Unit-II 15 Marks</td><td>Q.2 A) Attempt any Two (Each carry 05 Marks)
i) Theory
ii) Theory
iii) Theory
iv) Theory</td><td>10 Marks</td></tr>
<tr><td></td><td></td><td>Q.2 B) Attempt any One (Each carry 05 Marks)
i) Problem
ii) Problem</td><td>05 Marks</td></tr>
</table>

Name of the Course: Elective (ELP – II): Electronic Instrumentation Practical - II (2 Credits)

Sr. No.	Heading	Particulars
1	Description the course (Including but not limited to)	Introduction, Relevance, Usefulness, Application, Interest, Connection with other courses, Demand in the Industry, Job Prospects etc.
2	Vertical:	**Major**/Minor/Open Electives /Skill Enhancement / Ability Enhancement/Indian Knowledge System
3	Type:	**Practical**
4	Credits:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a Semester)
5	Hours:	**60 Hours**
6	Marks Allotted:	**50 Marks**
7	Course Objective (CO): The students are expected to	
	CO 1.	understand digital circuits like decoders, encoders, multiplexers, and their applications.
	CO 2.	learn logic design using K-map for combinational circuits.
	CO 3.	understand architecture, instruction set, data manipulation and memory operations of 8085 microprocessor.
	CO 4.	develop programming skills in C++ using loops, conditions, and functions.
	CO5.	apply theoretical concepts practically using simulators and coding exercises.
8	Course outcomes (OC): After successful completion of this course, the students will be able to:	
	OC 1.	acquire knowledge of designing and implementation of decoders, encoders, multiplexers, and demultiplexers.
	OC 2.	solve combinational logic problems using K-map effectively.
	OC 3.	write and execute assembly language programs for 8085 Microprocessor.
	OC 4.	write C++ programs using input/output, loops, and control statements.
	OC 5.	Obtaining various skills of C++ programming.
9	**List of Experiments:** 1. Study of 3:8 Decoder (74LS138), 8:3 Priority Encoder (74LS148) and their applications. 2. Study of 8:1 Multiplexer (74LS151), 1: 4 De-multiplexer (74LS155) and their applications. 3. Study of unidirectional buffer (74LS244) and bidirectional buffer (74LS245). 4. Design using K –map and implement 4:1 MUX, 1:4 DEMUX, 2bit comparator, Full adder and Full subtractor. [Note: Use suitable circuit simulator for implementation] 5. Designing (using K –map) and implementation of code convertors. (any two – Binary to Gray, Gray to Binary, BCD to Excess – 3 and Excess-3 to BCD) 6. 8085 Microprocessor: Write an assembly language program for code conversion (any two). 7. Write An ALP: a) To Evaluate simple arithmetic Expression (like Y= a x b + c x d where a, b, c and d are 8-bit HEX numbers) b) To Add parity bit to 7-bit ASCII characters. 8. 8085 Microprocessor: 8-bit data manipulation (Addition, subtraction, and multiplication). 9. 8085 Microprocessor: Arrange a given data in ascending/descending order. 10. 8085 Microprocessor: Transfer data from one memory block to another memory block. 11. 8085 Microprocessor: 16-bit Data manipulation (Addition, subtraction). 12. C++:	

	(a) Program based on Input, Output Statements. (Programs to read any two numbers through keyboard and to perform simple arithmetic operations and to display the result (b) Program based on Control Statements (i) Program based on if-else statement (ii) Program based on nested if statement 13. C++: (a) Program based on for loop, while loop and do-while loop. (b) Program using switch statements and if-else ladder. 14. C++: Program to study function declaration, function calling and function prototype. **Minimum 10 experiments from the list of experiments must be completed and reported in the journal.** **General Instructions:** • All the measurements and readings should be written with proper units in SI system only. • After completing all the required number of experiments in the semester and recording them in journal, student will have to get their journal certified and produce the certified journal at the time of practical examination to be eligible to appear in the Semester End Practical Examination • While evaluating practical, weightage should be given to diagram, observations, tabular representation, experimental skills and procedure, graph, calculation and result. • Skill of doing the experiment and its concepts should be more important than the accuracy of result. **Instruction Regarding Semester End Practical Examination** • For practical examinations, the learner will be examined in **One experiment** from the list of experiments. • Evaluation in viva voce will be based on regular experiments and skill experiments. • A candidate will be allowed to appear for the Semester End Practical Examination only if the candidate submit a certified journal at the time of practical examination or provide a certificate from the Head of the Department / Institute to the effect that the candidate has completed the practical course of that semester of T.Y.B. Sc. Physics as per the minimum requirement.
10	**Reference Books:** 1. R. P. Jain, Modern Digital Electronics, Tata McGraw Hill, 4th Edition. 2. Digital principles and applications: A.P. Malvino and D. P. Leach. Tata McGraw-Hill. 3. RG: Microprocessor Architecture, Programming and Applications with the 8085, Ramesh Gaonkar, 5th Edition. 4. EB: Object Oriented Programming with C++ by E Balagurusamy, Third / Fourth Edition, Tata McGraw-Hill Publishing Company Limited. **Additional Reference Books:** 1. Microprocessor and Applications by Vibhute and Borole, Techmax Publications. 2. Microprocessor, Principles & Applications by Gilmore (2nd Ed) TMH. 3. Programming with C++ by D. Ravichandran, Tata McGraw-Hill Publishing Company Limited. 4. Starting out with C++ by Tony Gaddis, Third Edition, Addison Wesley Publishing Company.

<table>
<tr><td></td><td colspan="3">5. Digital Electronics - by A.P Godse & D.A Godse Technical publications, Pune, Revised third edition, 2008. Pg. No:2.25-2.70 (for K-maps).</td></tr>
<tr><td rowspan="11">11</td><td colspan="3">Scheme of Examination:</td></tr>
<tr><td colspan="3">Semester End Practical Examination:
• The duration of Each Experiment in Semester End External Practical Examination will be of Two hours.
• The Semester End External Practical Examination will be for 30 marks as per the marking scheme given below:</td></tr>
<tr><td>Sr. No.</td><td>Activity</td><td>Total 30 Marks</td></tr>
<tr><td>1</td><td>One Experiments</td><td>20 Marks</td></tr>
<tr><td>2</td><td>Certified Journal</td><td>05 Marks</td></tr>
<tr><td>3</td><td>Viva</td><td>05 Marks</td></tr>
<tr><td colspan="3">Internal Practical Examination:
• The duration of Internal Practical Examination per experiment will be of Two hours.
• The Internal Practical Examination Pattern for 20 marks (During the Semester), will be as per the marking scheme given below:</td></tr>
<tr><td>Sr. No.</td><td>Activity</td><td>Total 20 Marks</td></tr>
<tr><td>1</td><td>Skill testing related any One Experiment</td><td>10 Marks</td></tr>
<tr><td>2</td><td>Overall performance</td><td>05 Marks</td></tr>
<tr><td>3</td><td>Viva-Voce</td><td>05 Marks</td></tr>
</table>

Name of the Course: Elective (ELP - II): Computer Science Practical - II (2 Credits)

Sr. No.	Heading	Particulars
1	Description the course (Including but not limited to)	Introduction, Relevance, Usefulness, Application, Interest, Connection with other courses, Demand in the Industry, Job Prospects etc.
2	Vertical:	**Major**/Minor/Open Electives /Skill Enhancement / Ability Enhancement/Indian Knowledge System
3	Type:	**Practical**
4	Credits:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a Semester)
5	Hours:	**60 Hours**
6	Marks Allotted:	**50 Marks**
7	Course Objective (CO): The students are expected to	
	CO 1.	apply microcontroller concepts to configure TIMER0/1 in different modes and handle external interrupts.
	CO 2.	develop assembly programs to implement timing and interrupt-driven applications.
	CO 3.	write Python programs for file handling, object-oriented design, and exception management.
	CO 4.	utilize NumPy, Pandas, and Matplotlib for array operations, data analysis, and visualization.
	CO5.	integrate microcontroller programming with Python skills to solve computational and real-world problems.
8	Course outcomes (OC): After successful completion of this course, the students will be able to:	
	OC 1.	apply knowledge of embedded systems and Python programming to practical tasks.
	OC 2.	analyze and design solutions for timing, interrupts, file handling, and data processing problems.
	OC 3.	use modern tools and libraries to implement, test, and visualize hardware and software applications.
	OC 4.	communicate and document solutions effectively while working independently or in teams.
	OC 5.	engage in continuous learning to adapt to evolving technologies in microcontrollers and data science.
9	**List of Experiments:** **Microcontrollers** 1. Study of TIMER 0/1 in Mode 0. 2. Study of TIMER 0/1 in Mode 1. 3. Study of TIMER 0/1 in Mode 2. 4. Study of External Interrupts INT0 / INT1. **Python Programming Exercises** 1. Write a Python program to read an entire text file. 2. Write a Python program to append text to a file and display the text. 3. Write a Python program to read last n lines of a file. 4. Design a class that store the information of student and display the same 5. Implement the concept of inheritance using python 6. Write a program to implement exception handling. 7. Write a program to create a 3D array of dimensions 4 *2 * 3. Initialize the array to some value. Find the maximum among each axis.	

	8. Write a program to create an array of shape 5 * 4 containing elements 1 to 20. Find the sum of the entire array as well as sums along each row and column. 9. Write a program to create a 50 elements array and fill it with odd numbers starting from 1. 10. Write a program to plot a sine and cosine curve in two different sub plots. Each curve should be drawn using 100 x coordinates between 1 and 5. 11. Practical based on defining Series from NumPy Arrays and other Series, filtering values, evaluating values. 12. Practical based on defining a Data Frame, selecting elements, assigning values, Membership of a value, deleting a column, filtering. 13. Practical based on Data Frame from nested dict. Transportation of Data Frame, Indexing. 14. Practical based on reading and writing data with Pandas, readers and writers, CSV and textual files. 15. Practical based on creating line plots, scatter plots with Matplotlib. 16. Practical based on creating bar charts, histogram with Matplotlib. **Minimum 10 experiments from the list of experiments must be completed and reported in the journal.** **General Instructions:** • All the measurements and readings should be written with proper units in SI system only. • After completing all the required number of experiments in the semester and recording them in journal, student will have to get their journal certified and produce the certified journal at the time of practical examination to be eligible to appear in the Semester End Practical Examination • While evaluating practical, weightage should be given to diagram, observations, tabular representation, experimental skills and procedure, graph, calculation and result. • Skill of doing the experiment and its concepts should be more important than the accuracy of result. **Instruction Regarding Semester End Practical Examination** • For practical examinations, the learner will be examined in One experiment from the list of experiments. • Evaluation in viva voce will be based on regular experiments and skill experiments. • A candidate will be allowed to appear for the Semester End Practical Examination only if the candidate submit a certified journal at the time of practical examination or provide a certificate from the Head of the Department / Institute to the effect that the candidate has completed the practical course of that semester of T.Y.B. Sc. Physics as per the minimum requirement.
10	**Reference Books:** 1. MMM - The 8051 Microcontroller & Embedded Systems by M.A. Mazidi, J.G. Mazidi and R. D. Mckinlay, Second Edition, Pearson 2. Intel's 8031/8051 Data sheet 3. Yashavant Kanetkar, Aditya Kanetkar: Let Us Python, 7th Edition 4. In addition to the reference books **internet web-sites & MOOC** can be used wherever necessary.
11	**Scheme of Examination:**
	Semester End Practical Examination: • The duration of Each Experiment in Semester End External Practical Examination will be of **Two hours.**

- The Semester End External Practical Examination will be for **30** marks as per the marking scheme given below:

Sr. No.	Activity	Total 30 Marks
1	One Experiments	20 Marks
2	Certified Journal	05 Marks
3	Viva	05 Marks

Internal Practical Examination:

- The duration of Internal Practical Examination per experiment will be of **Two hours**.
- The Internal Practical Examination Pattern for **20 marks** (During the Semester), will be as per the marking scheme given below:

Sr. No.	Activity	Total 20 Marks
1	Skill testing related any One Experiment	10 Marks
2	Overall performance	05 Marks
3	Viva-Voce	05 Marks

Letter Grades and Grade Points:

Semester GPA/ Programme CGPA Semester / Programme	% of Marks	Alpha-Sign / Letter Grade Result	Grading Point
9.00 - 10.00	90.0 - 100	**O** (Outstanding)	10
8.00 - < 9.00	80.0 - < 90.0	**A+** (Excellent)	9
7.00 - < 8.00	70.0 - < 80.0	**A** (Very Good)	8
6.00 - < 7.00	60.0 - < 70.0	**B+** (Good)	7
5.50 - < 6.00	55.0 - < 60.0	**B** (Above Average)	6
5.00 - < 5.50	50.0 - < 55.0	**C** (Average)	5
4.00 - < 5.00	40.0 - < 50.0	**P** (Pass)	4
Below 4.00	Below 40.0	**F** (Fail)	0
Ab (Absent)	-	**Ab** (Absent)	0

Sign of the BOS Chairman
Prof. Dr. T. N. GHORUDE
BOS in PHYSICS

Sign of the
Offg. Associate Dean
Prin M. R. Rajwade
Associate Dean
Faculty of Science

Sign of the
Offg. Dean
Prof Shivram Garje
Faculty of Science

As Per NEP 2020

University of Mumbai

Syllabus for Community Engagement Project (CEP)	
Faulty of Science & Technology	
Board of Studies in Physics	
Name of the Programme – B.Sc. (Physics)	
Semester	**V**
Duration	**30 hrs (Field Work+ Survey) + 15hrs (Discussion + Report Writing) : Total - 45 hrs**
From the Academic Year	**2026-27**

Name of Faculty:- Science and Technology
Name of Programme: - B.Sc. (Physics)
Duration:- 30 hrs (Field Work+ Survey) + 15hrs (Discussion + Report Writing) : Total - 45 hrs

Indicative Topics for CEP

Sr. No.	Name of the Topic
1	Renewable Energy Education - Demonstrating solar panels, wind turbines, or hydropower, and conducting energy audits for local buildings.
2	Waste Management Solutions - Educating the community on recycling, proper disposal of pharmaceutical waste, and the science of pollution.
3	Public Science Fairs & Demo Shows - Hosting interactive events featuring popular demonstrations like angular momentum (rotating chairs), air pressure (vortex cannons), and electromagnetism
4	School Visits & After-School Clubs -Teaching physics concepts to K-12 students through hands-on projects like building rockets, robots, or simple circuits.
5	Virtual Labs and Mentoring- Developing online, accessible physics simulations for schools without laboratories.
6	Medical Imaging Education- Demystifying technologies like X-rays, MRI, and ultrasound for the public.
7	Radiation Safety Awareness- Explaining the physics behind radiation therapy (e.g., "If radiation can cause cancer, how can it cure it?").
8	Health Technology Tools- Demonstrating everyday physics in health, such as how pulse oximeters work.
9	Citizen Science Projects- Engaging the public in analyzing astronomical data, such as star tracking or searching for dark matter.
10	Stargazing Nights- Using telescopes to show local communities celestial bodies and explaining astrophysics concepts.
11	Art and Science Fusion- Collaborating with artists to create interactive exhibits that explain physical concepts like light and color.
12	Creating Awareness - Electricity Saving Mechanisms, Use of Solar Power, Electronic Waste Management etc.
13	Steet Plays - demonstrating various physics concepts to society, the importance of science, twice-yearly events where undergraduates demonstrate physics concepts to the public.
14	Organize workshops to demonstrate physics concepts in everyday activities, such as cooking, cycling, or music.
15	Host a science fair where students can showcase physics-based projects, such as homemade telescopes, electric circuits, or simple machines.
16	Develop interactive physics experiments for school kids, focusing on topics like motion, light, or sound.
17	Collaborate with local communities to install solar panels or wind turbines, teaching physics principles behind renewable energy.
18	Explore the physics behind sports, such as projectile motion in cricket or football, and conduct workshops or demonstrations.
19	Safety & Social Applications Physics of Fire Safety and Disaster Management.
20	Understanding Earthquakes: Physics and Community Preparedness.

The topics are indicative and the faculty members should allot Community Engagement Project that are relevant and important as per core Subject. The Community Engagement Project may be taken individual or in a group up to 5 students with proper guidance from Faculty.

Evaluation Pattern:-

Evaluation during CEP Program involves two key components:-

External Evaluation 60% (30 Marks)

Internal Evaluation 40% (20 Marks)

Evaluation Chart

(i) External Evaluation (Marks 30)

Criteria	Marks
Objectives, Literature Review , Methodology, Data Analysis, Conclusion and Recommendations	15
Overall Project Report Structure and Style	5
Presentation Skills & Communication	10
Total	30

(ii) Internal Evaluation by Guide (Marks 20)

Criteria	Marks
Attendance, Community interactions completion and interaction with Supervisor	10
Overall Report quality	10
Total	20

*** Please see the Guidelines for Community Engagement Project for UG Students, as per NEP 2020**

Sd/-
Sign of the
Prof. (Dr.) T. N. Ghorude
Chairman
BOS in Physics

Sd/-
Sign of the
Offg. Associate Dean
Dr. Madhav R. Rajwade
Faculty of Science & Technology

Sd/-
Sign of the Offg. Dean
Prof. Shivram S. Garje
Faculty of Science & Technology