HSNC University , Mumbai

Board of Studies in Faculties of Science and Technology

Board of Studies in Physics

1. **Name of Chairperson/Co-ChairpersonCoordinator**
    a. Mrs. Anita Ravi (Associate Professor and HOD, Department of Physics, K C College, Mumbai.)anita.ravi@kccollege.edu.in 9892121767

2. **Two to five teachers each having minimum five years teaching experience amongst the full-time teachers of the Department in the relevant subject**
    a. Dr. Shaila Wagle, Associate Professor, Department of Physics, K C College shaila_wagle@yahoo.com 9820122689
    b. Dr. Jyotsna Pandey, Assistant Professor, Department of Physics, K C College jyotsna.pandey@kccollege.edu.in 9664466033

3. **One Professor/Associate Professor from other Universities or Professor/Associate Professor named by Parent Body ; nominated by Parent Body**
    a. Dr. Anuradha Mishra Professor & Head, Department of Physics, Mumbai University, misra@physics.mu.ac.in 9867016176

4. **Four external experts from industry/research/eminent scholar in the field relevant to the subject nominated by the Parent Body**
    a. Dr. G P Kothiyal, Former Head, Glass and Ceramics Division, BARC, Current Chairman, Material Science Research Centre, gpkothiyal@yahoo.co.in 9757000215
    b. Dr. Dinesh Kala, Associate Professor & HOD, G N Khalsa College. kaladc10964@gmail.com 9892109094
    c. Dr. Mohan Narayan, Associate Professor & HOD, Department of Physics, Institute of Chemical Technology, Mumbai m.narayan@ictmumbai.edu.in 9892906162
    d. Dr. A P Jayaraman, President, STEAM Academy, Former Nuclear scientist, BARC, Chairman, National Centre for Science Communicators drap.jayaraman@gmail.com, 9819966601

5. **Top Ranking student**
    a. Ms. Ashlesha Pujara, Top Ranking Ex-student (2017 -19 batch) Department of Physics, K C College pujaraashlesha@gmail.com 9867850315

Part –I

Outline of Choice Based Credit System as outlined by University Grants Commission:

R. **: The Definitions of The Key Terms Used in The Choice Based Credit System And Grading System Introduced From TheAcademicYear2020-2021AreAs Under:**

1. **Core Course:** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

2. **Elective Course:** Generally, a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

   2.1 **Discipline Specific Elective (DSE) Course**: Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

   2.2 **Dissertation/Project:** An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project. A Project/Dissertation work would be of 6 credits. A Project/Dissertation work may be given in lieu of a discipline specific elective paper.

   2.3 **Generic Elective (GE) Course:** An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.
   P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.

3. **Choice Base Credit System:** CBCS allows students to choose inter- disciplinary, intra-disciplinary courses, skill-oriented papers (even from other disciplines according to their learning needs, interests and aptitude) and more flexibility for students.

4. **Honors Program:** To enhance employability and entrepreneurship abilities among the learners, through aligning Inter Disciplinary / Intra Disciplinary courses with Degree Program. Honours Program will have 40 additional credits to be undertaken by the learner across three years essentially in Inter / Intra Disciplinary course.

   A learner who joins Regular Undergraduate Program will have to opt for Honours Program in the first year of the Program. However, the credits for honours, though divided across three years can be completed within three years to become eligible for award of honours Degree.

5. **Program:** A Program is a set of course that are linked together in an academically meaningful way and generally ends with the award of a Degree Certificate depending on the level of knowledge attained and the total duration of study, B.Sc. Programs.

6. **Course:** A 'course' is essentially a constituent of a 'program' and may be conceived of as a composite of several learning topics taken from a certain knowledge domain, at a certain level. All the learning topics included in a course must necessarily have academic coherence, i.e. there must be a common thread linking the various components of a course. A number of linked courses considered together are in practice, a 'program'.

7. **Bridge Course:** Bridge course is visualized as Pre semester preparation by the learner before commencement of regular lectures. For each semester the topics, whose knowledge is considered as essential for effective and seamless learning of topics of the Semester, will be specified. The Bridge Course can be conducted in online mode. The Online content can be created for the Bridge Course Topics.

8. **Module and Unit:** A course which is generally an independent entity having its own separate identity, is also often referred to as a 'Module' in today's parlance, especially when we refer to a 'modular curricular structure'. A module may be studied in conjunction with other learning modules or studied independently. A topic within a course is treated as a Unit. Each course should have exactly 3 Units.

9. **Self-Learning: 20% of the topics will be marked for Self-Learning.** Topics for Self-Learning are to be learned independently by the student, in a time- bound manner, using online and offline resources including online lectures, videos, library, discussion forums, fieldwork, internships etc.

   Evaluative sessions (physical/online), equivalent to the credit allocation of the Self Learning topics, shall be conducted, preferably, every week for each course. Learners are to be evaluated real time during evaluative sessions. The purpose of evaluative sessions is to assess the level of the students' learning achieved in the topics are marked for Self-Learning.

   The teacher's role in these evaluative sessions will be that of a Moderator and Mentor, who will guide and navigate the discussions in the sessions, and offer concluding remarks, with proper reasoning on the aspects which may have been missed by the students, in the course of the Self-Learning process.

   The modes to evaluate self-learning can be a combination of the various methods such as written reports, handouts with gaps and MCQs, objective tests, case studies and Peer learning. Groups can be formed to present self- learning topics to peer groups, followed by Question-and-Answer sessions and open discussion. The marking scheme for Self-Learning will be defined under Examination and Teaching.

The topics stipulated for self-learning can be increased or reduced as per the recommendations of the Board of Studies and Academic Council from time to time. All decisions regarding evaluation need to be taken and communicated to the stakeholders preferably before the commencement of a semester. Some exceptions may be made in exigencies, like the current situation arising from the lockdown, but such adhoc decisions are to be kept to the minimum possible.

10. **Credit Point:** Credit Point refers to the 'Workload' of a learner and is an index of the number of learning hours deemed for a certain segment of learning. These learning hours may include a variety of learning activities like reading, reflecting, discussing, attending lectures / counseling sessions, watching especially prepared videos, writing assignments, preparing for examinations, etc. Credits assigned for a single course always pay attention to how many hours it would take for a learner to complete a single course successfully. A single course should have, by and large a course may be assigned anywhere between 2 to 8 credit points wherein 1 credit is construed as corresponding to approximately 30 to 40 learning hours.

11. **Credit Completion and Credit Accumulation:** Credit completion or Credit acquisition shall be considered to take place after the learner has successfully cleared all the evaluation criteria with respect to a single course. Thus, a learner who successfully completes a 4 CP (Credit Point) course may be considered to have collected or acquired 4 credits. learner level of performance above the minimum prescribed level (viz. grades / marks obtained) has no bearing on the number of credits collected or acquired. A learner keeps on adding more and more credits as he completes successfully more and more courses. Thus, the learner 'accumulates' course wise credits.

12. **Credit Bank:** A Credit Bank in simple terms refers to stored and dynamically updated information regarding the number of Credits obtained by any given learner along with details regarding the course/s for which Credit has been given, the course-level, nature, etc. In addition, all the information regarding the number of Credits transferred to different programs or credit exemptions given may also be stored with the individual's history.

13. **Credit Transfer:** (performance transfer) When a learner successfully completes a program, he/she is allowed to transfer his/her past performance to another academic program having some common courses and Performance transfer is said to have taken place.

14. **Course Exemption:** Occasionally, when two academic programs offered by a single university or by more than one university, may have some common or equivalent course-content, the learner who has already completed one of these academic programs is allowed to skip these 'equivalent' courses while registering for the new program. The Learner is 'exempted' from 'relearning' the common or equivalent content area and from re-appearing for the concerned examinations. It is thus taken for granted that the learner has already collected in the past the credits corresponding to the exempted courses.

Part-II

O*** The fees for transfer of credits or performance will be based on number of credits that a learner has to complete for award of the degree.**

The Scheme of Teaching and Examination:

The performance of the learners shall be evaluated in two components: Internal Assessment with 40% marks by way of continuous evaluation and by Semester End Examination with 60% marks by conducting the theory examination.

INTERNAL ASSESSMENT: - It is defined as the assessment of the learners on the basis of continuous evaluation as envisaged in the credit-based system by way of participation of learners in various academic and correlated activities in the given semester of the programme.

A). Internal Assessment – 40% 40 marks

Practical's (internal Components of the Practical Course

1. For Theory Courses

Sr. No.	Particulars	Marks
1	**ONE** class test / online examination to be conducted in the given semester	15 Marks
2	One assignment based on curriculum (to be assessed by the teacher Concerned	10 Marks
3	Self-Learning Evaluation	10 Marks
4	Active participation in routine class instructional deliveries	05 Marks

2. For Courses with Practicals

Each practical course can be conducted out of 50 marks with 20 marks for internal and 30 marks for external

Practical's (Internal component of the Practical Course)

Sr. No	Evaluation type	Marks
1	Two Best Practicals /Assignments/Presentation /Preparation of models/ Exhibits **Or** One Assignment/ project with class presentation to be assessed by teacher concerned	10
2	Journal	05
3	Viva	05

The semester end examination (external component) of 60 % for each course will be as follows:

i) **Duration – 2 Hours** ii) **Theory Question Paper**

Pattern: -

1. There shall be four questions each of 15 marks. On each unit there will be one question and the fourth one will be based on entire syllabus.
2. All questions shall be compulsory with internal choice within the questions. (Each question will be of 20 to 23 marks with options.)
3. Question may be subdivided into sub-questions a, b, c… and the allocation of marks depend on the weightage of the topic.

The marks will be given for all examinations and they will be converted into grade (quality) points. The semester-end, final grade sheets and transcripts will have only credits, grades, grade points, SGPA and CGPA.

3. **Project and Assignment:**

Project or Assignment, which can in the following forms

- Case Studies
- Videos
- Blogs
- Research paper (Presented in Seminar/Conference)
- Field Visit Report
- Presentations related to the subject (Moot Court, Youth Parliament, etc.)
- Internships (Exposition of theory into practice)
- Open Book Test
- any other innovative methods adopted with the prior approval of Director Board of Examination and Evaluation.

4. **Self-Learning Evaluation**

- **20% OF THE TOPICS OF CURRICULUM ARE LEARNED BY THE STUDENT THROUGH SELF LEARNING USING ONLINE / OFFLINE ACADEMIC RESOURSE SPECIFIED IN THE CURRICULUM.**

- **HENCE 20% OF THE LECTURES SHALL BE ALLOCATED FOR EVALUATION OF STUDENTS ON SELF LEARNING TOPICS**

- The identified topics in the syllabus shall be learnt independently by the students in a time bound manner preferably from online resources. Evaluative sessions shall be conducted by the teachers and will carry 10 Marks.

- CLUB The self-learning topics into 3-4 GROUPS OF TOPICS ONLY FOR EVALUATION.

- **PRESCRIBE TIME DURATION (IN DAYS) FOR COMPLETION OF EACH GROUP OF TOPIC AND EARMARK SELF LEARNING EVALUATION LECTURES IN THE TIMETABLE. HENCE EACH GROUP OF TOPIC CAN BE ASSIGNED 3 REGULAR LECTURES FOR THIS EVALUATION FOR ENTIRE CLASS**

  3 Sub Topics

  Each evaluative session shall carry 3 Marks (3 x 3 Units = 9 Marks). Students who participate in all evaluative sessions shall be awarded 1 additional Mark.

  4 Sub Topics

  Each evaluative session shall carry 2.5 Marks (2.5 x 4 Units = 10 Marks)

- **EVALUATION OF SELF LEARNING TOPICS CAN COMMENCE IN REGULAR LECTURES ASSIGNED FOR SELF LEARNING EVALUATION IN THE TIMETABLE**

  3 Evaluative sessions
  Each evaluative session shall carry 3 Marks (3 x 3 = 9 Marks). Students who participate in all evaluative sessions shall be awarded 1 additional Mark
  4 **Evaluative sessions**
  Each evaluative session shall carry 2.5 Marks (2.5 x 4 = 10 Marks).

  Methods for Evaluation of Self-learning topics:

- Seminars/presentation (PPT or poster), followed by Q&A – Objective questions /Quiz / Framing of MCQ questions.
- Debates
- Group discussion
- You-Tube videos (Marks shall be based on the quality and viewership)
- Improvisation of videos
- Role Play followed by question-answers

TEACHERS CAN FRAME OTHER METHODS OF EVALUATION ALSO PROVIDED THAT THE METHOD, DULY APPROVED BY THE COLLEGE EXAMINATION COMMITTEE, IS NOTIFIED TO THE STUDENTS AT LEAST 7 DAYS BEFORE THE COMMENCEMENT OF THE EVALUATION SESSION AND IS FORWARDED FOR INFORMATION AND NECESSARY ACTION AT LEAT 3 DAYS BEFORE THE COMMENCEMENT OF THE EVALUATION SESSION

- Viva Voce
- Any other innovative method

SEMESTER END EXAMINATION: - It is defined as the examination of the learners on the basis of performance in the semester end theory / written examinations.

B. Semester End Examination- 60 % ***60 Marks***

1) Duration – These examinations shall be of 2 Hours duration.
2) Question Paper Pattern: -
   i. There shall be four questions each of 15 marks.
   ii. All questions shall be compulsory with internal choice within the questions.
   iii. Question may be sub-divided into sub-questions a, b, c, d & e only and the allocation of marks depends on the weightage of the topic.

THE MARKS OF THE INTERNAL ASSESSMENT SHOULD NOT BE DISCLOSED TO THE STUDENTS TILL THE RESULTS OF THE CORRESPONDING SEMESTER IS DECLARED.

HSNC University Mumbai

(2021-2022)

Ordinances and Regulations

With Respect to

Choice Based Credit System

(CBCS)

For the Programmes Under

The Faculty of Science and Technology

For the Course

PHYSICS

Semester-III and Semester -IV

With effect from the Academic year 2021-2022

Program: B.Sc
Subject: Physics
Year: Second Year
Semesters: III and IV

Preamble:
This syllabus is a part of the B.Sc Program in Physics of the Hyderabad and Sind National Collegiate University to be taught in Semesters 3 and 4 from the academic year 2021-22 onwards.
This syllabus aims to provide adequate skills, training and knowledge to the students which enhance their thinking and application abilities.
The theory courses of both semesters comprising of Mathematical Physics, Mechanics, Thermal Physics, Optics and Electronics are devoted to core Physics.
The detailed syllabus in each theory course is designed to fit in with the existing First Year syllabus of the Program in terms of continuity. The Second-Year syllabus mainly seeks to orient the learner towards applications of the laws and principles of Physics imparted to them in the First Year.
The Practical courses of both semesters strives to maintain a close connection with the theory courses with the purpose of providing the learner an immediate exposure to an aspect of experiential learning.

Objectives:

Upon completion of the Second Year of the B. Sc Program in Physics with this syllabus the Learner should be able to:
1. acquire good knowledge and understanding of concepts, principles, and experimental findings in the areas of core Physics such as Mathematical Physics, Mechanics, Thermal Physics, Optics and Electronics.
2. think critically and acquire high problem-solving abilities.
3. through the self-learning component work effectively in a team and present complex technical concepts in a clear, precise, concise, and simple language for better understanding.
4. through the self-learning component identify, mobilize appropriate resources required for a project and manage a project to its completion in a responsible manner.
5. use computers for simulation studies in Physics and appropriate software for numerical and statistical analysis of data.
6. learn to access websites of renowned Physics laboratories in order to locate, retrieve and evaluate information related to Physics.

The Scheme of Teaching and Examination is as under:
Second Year - Semester – III
Summary

Sr. No.	Choice Based Credit System	Course Code	Remarks
1	Core Course **(Physics)**	US-SPH-301, US-SPH-302, US-SPH-303, US-SPH-P3	

Detail Scheme

Sr	Course Code	Course Title	Periods Per Week					Credit	Seasonal Evaluation Scheme					Total Marks
			Units	S.L.	L	T	P		SLE	CT	TA	Attendance	SEE	
1	US-SPH-301	Mathematical Physics - 2	3	20 %*	2	1	0	2	10	15	10	05	60	100
2	US-SPH-302	Mechanics - 2	3	20 %*	2	1	0	2	10	15	10	05	60	100
3	US-SPH-303	Electronics I	3	20 %*	2	1	0	2	10	15	10	05	60	100
4	US-SPH-P3	Practical based on US-SPH-301 + Practical based on US-SPH-302 + Practical based on US-SPH-303	-	-	0	0	9	3	-	-	-		150 (40 + 5 + 5 + 40 + 5 + 5 + 40 + 5 + 5)	150
Total Hours / Credit								09	Total Marks					450

***One to two lectures to be taken for CONTINUOUS self -learning Evaluation.**

II Year - Semester – III - Units – Topics – Teaching Hours

S. No	Course Code	Course Unit		Hours/ Lectures	Total No. of hours/ lectures	Credit	Total Marks
		No	Title				
1	US-SPH-301	I	**Fourier Series**	15	45	2	100 (60+40)
		II	**(i) Fourier Transforms** **(ii) Some Special Integrals**	15			
		III	**Partial Differential Equations**	15			
2	US-SPH-302	I	**Rotational Dynamics**	15	45	2	100 (60+40)
		II	**(i) Central Force Motion** **(ii) Forced Oscillations** **(iii) Non-Inertial systems**	15			
		III	**Special Theory of Relativity**	15			
3	US-SPH-303	I	**(i) Digital Circuits** **(ii) Arithmetic Circuits**	15	45	2	100 (60+40)
		II	**(i) Diodes and its Applications in Regulated Power Supplies** **(ii) Bipolar Transistors**	15			
		III	**Amplifiers**	15			

4	US-SPH -P3		Practical based on US-SPH- 301, US-SPH -302 & US-SPH- 303	-	66	3	150 (40 + 5 + 5 + 40 + 5 + 5 + 40 + 5 + 5)
			TOTAL			9	450

Curriculum topics with Self-Learning topics - to be covered through self-learning mode along with the respective Unit. Evaluation of self-learning topics to be undertaken before the concluding lecture instructions of the respective UNIT.

Course Name: Mathematical Physics 2

Course Code: US - SPH – 301

Learning Outcomes:

- Learn about Fourier analysis of periodic functions, functions with arbitrary period, and nonperiodic functions. Learn about their applications and about summing of infinite series.
- Learn about Fourier transform, inverse Fourier transform and their applications
- Learn about beta, gamma and error functions and their applications to solve integrals.
- Learn about methods of solving various partial differential equations applicable to important phenomena in Physics

Unit	Content	No. of Lectures
1	**1. Fourier Series:** Periodic Functions, Orthogonality of sine and cosine functions, Dirichlet conditions (statement only), Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients, Complex representation of Fourier series, Expansion of functions with arbitrary period, Expansion of nonperiodic functions over an interval, Even and odd functions and their Fourier expansions, Application, Summing of infinite series, Term by term differentiation and integration of Fourier series, Parseval Identity.	**15**
2	**2. Fourier Transforms and Some Special Integrals:** **2.1 Fourier Transforms:** Fourier integral theorem, Fourier transforms, Examples, Fourier transform of trigonometric, Gaussian, finite wave train and other functions, Fourier transform of derivatives, Inverse Fourier transform, Convolution theorem, Properties of Fourier transforms (translation, change of scale, complex conjugation etc.), Application of Fourier transforms to differential equations: one dimensional wave and diffusion/heat flow equations. **2.2 Some Special integrals:** Beta and Gamma functions and relation between them, Expression of integrals in terms of Gamma functions, Error function (probability integral)	**10** **05**
3	**3. Partial Differential Equations:**	**15**

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

Self-Learning topics (Unit wise)

Unit	Topics
I	Periodic functions, Orthogonality of sine and cosine functions, Dirichlet conditions (statement only)
II	Application of Fourier transforms to differential equations: one dimensional wave and diffusion/heat flow equations.
III	Wave equation and its solution for vibrational modes of a stretched string, rectangular and circular membranes

Online Resources

Reference:- http// nptel.ac.in

Reference Books:

1. Mathematical Methods in the Physical Sciences, 3rd edition, Mary L Boas, Wiley Eastern
2. Essential Mathematical Methods, K F Riley and M P Hobson, 2011, Cambridge University Press
3. Mathematical Methods for Physicists, Arfken, Weber, 2005, Harris, Elsevier
4. Fourier Analysis M R Spiegel, 2004, Tata McGraw-Hill
5. Engineering Mathematics by S Pal and S C Bhunia, 2015, Oxford University Press

Course Name: Mechanics 2
Course Code: US - SPH – 302
Learning Outcomes:

- Learn about angular momentum and its conservation principle
- Learn to write the expressions for moment of inertia about the given axis of symmetry for different uniform mass distributions
- Learn about application of translational and rotational motions simultaneously in certain phenomena such as rolling of a disc without slipping on a plane surface
- Learn about central force and its application to motion of planets and satellites
- Learn about forced oscillations and resonance
- Learn about presence of fictitious forces in non-inertial frames and their implications
- Learn about relativistic effects in Special Theory of Relativity.

Unit	Content	No. of Lectures

1	**1. Rotational Dynamics:** Angular momentum of a particle and a system of particles, Torque, Principle of conservation of angular momentum, Rotation about a fixed axis, Moment of inertia, Kinetic energy of rotation, Motion involving both rotation and translation.	**15**
2	**2. Central Force Motion, Forced Oscillations and Non-inertial Systems:** **2.1 Central Force Motion:** Motion of a particle under a central force field, Two-body problem, and its reduction to one -body problem and its solution, The energy equation and energy diagram, Kepler's laws, Satellite in circular orbit and applications, Geosynchronous orbits, Weightlessness, Basic idea of global positioning systems (GPS). **2.2 Forced Oscillations:** Transient and steady states, Resonance, Sharpness of resonance, Power dissipation, Quality factor. **2.3 Non-inertial Systems:** Non-inertial frames and fictitious forces, Uniformly rotating frame, Laws of Physics in uniformly rotating coordinate systems, Centrifugal force, Coriolis force and its implications.	**05** **03** **07**
3	**3. Special theory of Relativity:** Michelson-Morley experiment and its outcome, Postulates of Special Theory of Relativity, Lorentz transformations, Simultaneity and order of events, Length contraction, Time dilation, Geometrical interpretation, Relativistic transformation of velocity, frequency and wave number, Relativistic addition of velocities, Variation of mass with velocity, Massless particles, Mass-energy equivalence, Relativistic Doppler effect, Relativistic kinematics, Transformation of energy and momentum.	**15**

Self-Learning topics (Unit wise)

Unit	Topics
I	Angular momentum of a particle and a system of particles, Torque
II	Basic idea of global positioning systems (GPS)
III	Simultaneity and order of events, Length contraction, Time dilation, Geometrical interpretation

Online Resources

Reference:- http// nptel.ac.in

Reference Books:

1. An introduction to Mechanics by D. Kleppner, R J Kolenkow, 2010, Mc-Graw Hill
2. Mechanics, Berkeley Physics, Volume I, C Kittel, W Knight, et.al. 2007, Tata McGraw Hill
3. Physics, Resnick, Halliday and Walker, 2008, 8th ed. Wiley
4. Analytical Mechanics, G R Fowles and G L Cassiday, 2005, Cengage Learning.
5. Feynman Lectures Volume I, R P Feynman, R B Leighton, M Sands, 2008, Pearson

Education.
6. Introduction to Special Relativity, R Resnick, 2005, John Wiley and Sons.
7. University Physics, Roland Lane Resse, 2003, Thomson Brooks/Cole
8. Engineering Mechanics, Basudeb Bhattacharya, 2nd edition, 2015, Oxford University Press

Additional Reference Books:

1. Mechanics, D S Mathur, S Chand and Company Ltd. 2000.
2. Theoretical mechanics, M R Spiegel, Tata Mc-Graw Hill, 2006.

Course Name: Electronics 1
Course Code: US - SPH – 303

Learning Outcomes:

- Learn about analog systems and digital system, logic gates and number systems
- Learn about p-n junctions and biasing. Application of p-n junctions in rectifiers and voltage regulation
- Learn about n-p-n and p-n-p transistors and basic configuration, transistor biasing, current and voltage gain
- Learn about coupled amplifiers.

Unit	Content	No. of Lectures
1	**1 Digital Circuits, Arithmetic Circuits:** **1.1 Digital Circuits:** Difference between analog and digital circuits, Binary numbers, Hexadecimal numbers, Conversion from one number system to another, AND, OR and NOT gates, De Morgan's theorem, NAND and NOR gates as universal gates, XOR gate **1.2 Arithmetic Circuits:** Binary addition and subtraction, Half adder and full adder, Half subtractor and full subtractor, Hexadecimal addition, Hexadecimal subtraction	**09** **06**
2	**2 Diodes and its Application in Regulated Power Supplies, Bipolar Transistors:** **2.1 Diodes and its Application in Regulated Power Supplies:** P-N junction and biasing, Half wave rectifier, Center tapped full wave rectifier and bridge full wave rectifier, Calculation of ripple factor, rectification efficiency and comparative study, C filter, Zener diodes and voltage regulation. **2.2 Bipolar Transistors:** NPN and PNP transistors, Characteristics of CB, CC and CE configuration, Current gain α and β, Relation between α and β, Load line analysis of transistors, DC load line and Q-point, Active, cutoff and saturation regions.	**08** **07**
3	**3 Amplifiers:** **3.1 Amplifiers**: Transistor biasing and stabilization circuits, Fixed bias and voltage divider bias, CE configuration, Transistor as two port network, h parameter equivalent circuit, Analysis of single stage amplifier using hybrid model, Input-output impedance, Current, voltage and power gain, Classification of class A, B and C amplifiers **3.2 Coupled Amplifier:** Two stage RC coupled amplifier and its frequency response	**12** **03**

Self-Learning topics (Unit wise)

Unit	Topics
I	AND, OR and NOT gates, Half subtractor and Full subtractor
II	PN junction and biasing, Half wave rectifier
III	Classification of class A, B and C amplifiers

Online Resources

Reference: - http// nptel.ac.in

Reference Books:

1. Digital Principles and Applications, A.P. Malvino, D.P. Leach and Saha, 7th edition 2011, Tata McGraw
2. Digital Computer Electronics, A.P. Malvino and J.A. Brown, McGraw Hill Education
3. Fundamentals of Digital Circuits, Anand Kumar, 2nd edition, 2009, PHI Learning Pvt. Ltd
4. Digital Circuits and system, Venugopal, 2011, Tata McGraw Hill
5. Digital Electronics, J.K.Kharate, 2010, Oxford University Press
6. Digital systems: Principles and Applications, R.J. Tocci, N.S.Widmer, 2001, PHI Learning
7. Logic Circuit Design, Shimon P. Vingron, 2012, Springer
8. Modern Digital Electronics, R.P. Jain, 4th edition, Tata McGraw Hill
9. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning
10. Digital Electronics, S.K. Mandal, 2010, 1st edition, Tata McGraw Hill
11. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata McGraw Hill
12. Electronics: Fundamentals and applications, J.D.Ryder, 2004,Prentice Hall
13. Solid state Electronic Devices, B.G. Streetman and B.G. Banerjee, 6th edition, 2009 PHI Learning
14. Electronic Devices and circuits, S. Salivahanan, N.S. Kumar, 3rd edition, 2012, Tata Mc-Graw Hill.
15. Electronic circuits: Handbook of design and applications, U. Tietze, C. Schenk, 2008, Springer
16. Semiconductor Devices: Physics and Technology, S.M. Sze, 2nd edition, 2002, Wiley India
17. Electronic Devices and Circuits, Allen Mottershead, Prentice Hall

Course Name: Practical Course 3
(Practical based on US-SPH-301, US-SPH-302 & US – SPH - 303)
Course Code: US-SPH- P3

Learning Outcomes:

- In laboratory course, the students will able to correlate theory concepts with practical.

CONTENTS	**Lectures**
Section I (Practical based on US-SPH-301) 1. Evaluation of the Fourier coefficients of a given periodic function. 2. Application of Fourier transforms. 3. Application of Fourier transforms. 4. Application of Partial Differential Equations. **Section II (Practical based on US-SPH-302)** 1. Moment of inertia of a rectangular rod. 2. Resonance pendulum. 3. LCR series resonance. 4. Transient response of a series LCR circuit. **Section III (Practical based on US-SPH-303)** 1. NAND-NOR gates as universal building blocks 2. Verification of De Morgan's theorems. 3. Half adder and full adder.	3 lectures per experiment

4. Bridge rectifier: voltage regulation and ripple factor. 5. Zener regulator. 6. To design CE amplifier with given gain (mid-gain) using voltage divider bias. 7. Frequency response of CE amplifier.	

Reference Books:

1. Mathematical Methods for Physics and engineers K F Riley, M P Hobson and S J Bence, 3rd edition, 2006, Cambridge University Press.
2. Simulation of ODE/PDE models with MATLAB ®, OCTAVE and SCILAB: Scientific and Engineering Applications: A W Vouwer, P Saucez, C V Fernandez, 2014, Springer Advanced Practical Physics for Students, B L Flint and H T Worsnop, 1971, Asia nPublishing House
3. A Textbook of Practical Physics, I Prakash and Ramakrishna, 11th edition, 2011, Kitab Mahal.
4. Engineering Practical Physics, S Panigrahi and B Mallick, 2015, Cengage Learning India Pvt. Ltd
5. Practical Physics, G L Squires, 2015, 4th edition, Cambridge University Press.
6. Modern Digital Electronics, R.P. Jain, 4th edition, Tata McGraw Hill
7. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Milller (1994), Mc-Graw Hill
8. Electronic Principles, A.P. Malvino, Tata McGraw Hill
9. Electronic devices and circuit Theory, R.L. Boylestad & L.D. Nashelsky, 2009,Pearson

Note:

1. A minimum of 3 experiments must be performed from each section and reported in the journal.
2. The certified journal must contain a minimum of 12 experiments.
3. A separate index for each section is a must in the journal.
4. A certificate of completion of the Practical course is a must.

The Scheme of Teaching and Examination is as under:

Second Year - Semester – IV
Summary

Sr. No.	Choice Based Credit System	Course Code	Remarks
1	Core Course **(Physics)**	US-SPH-401, US-SPH-402, US-SPH-403 US-SPH-P4	

Detail Scheme

Sr	Course Code	Course Title	Periods Per Week					Credit	Seasonal Evaluation Scheme					Total Marks
			Units	S. L.	L	T	P		SLE	CT	TA	Attendance	SEE	
1	US-SPH-401	Optics	3	20 %*	2	1	0	2	10	15	10	05	60	100
2	US-SPH-402	Thermal Physics	3	20 %*	2	1	0	2	10	15	10	05	60	100
3	US-SPH-403	Electronics 2	3	20 %*	2	1	0	2	10	15	10	05	60	100
4	US-SPH-P4	Practical based on US-SPH-401 + Practical based on US-SPH-402 + Practical based on US-SPH-403	-	-	0	0	9	3	-	-	-		150 (40 + 5 + 5 + 40 + 5 + 5 + 40 + 5 + 5)	150
Total Hours / Credit								09	Total Marks					450

***One to two lectures to be taken for CONTINUOUS self -learning Evaluation.**

II Year - Semester – IV - Units – Topics – Teaching Hours

S. No	Course Code	Course Unit		Hours/ Lectures	Total No. of hours/ lectures	Credit	Total Marks
		No	Title				
1	US-SPH 401	I	**(i) Wave Optics** **(ii) Interference of Light Waves**	15	45	2	100 (60+40)
		II	**(i) Diffraction** **(ii) Fresnel's Diffraction** **(iii) Fraunhofer Diffraction**	15			
		III	**(i) Polarization** **(ii) Resolving Power** **(iii) LASER**	15			
2	US-SPH -402	I	**(i) Velocity Distribution in an Ideal Gas** **(ii) Molecular Collisions in an Ideal Gas**	15	45	2	100 (60+40)
		II	**Real gases**	15			
		III	**(i) First law of thermodynamics** **(ii) Second law of thermodynamics**	15			
3	US-SPH -403	I	**(i) Boolean Algebra** **(ii) Sequential circuits**	15	45	2	100 (60+40)
		II	**(i) Feedback in Amplifier** **(ii) Sinusoidal Oscillators** **(iii) Timer**	15			
		III	**Operational Amplifier (Black body Approach) and its applications**	15			
4	US-SPH -P4	I	Practical based on US-SPH- 401, US-SPH -402 & US-SPH- 403	-	66	3	150 (40 + 5 + 5 + 40 + 5 + 5 + 40 + 5 + 5)
			TOTAL			9	450

Curriculum topics with Self-Learning topics - to be covered through self-learning mode along with the respective Unit. Evaluation of self-learning topics to be undertaken before the concluding lecture instructions of the respective UNIT.

Course Name: Optics
Course Code: US - SPH – 401

Learning Outcomes:

- Understand the physics of interference, diffraction, and polarization.
- Learns about resolving power of optical instruments
- Learns about production, properties, and types of Lasers.

Unit	Content	No. of Lectures
1	**1. Wave Optics, Interference of light waves:** **1.1 Wave Optics:** Electromagnetic nature of light, Definition and properties of wave front, Huygens Principle, Temporal and Spatial Coherence. **1.2 Interference of light waves:** Division of amplitude and wavefront, Interference in thin films: parallel and wedge-shaped films, fringes of equal inclination (Haidinger Fringes); fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index, Michelson Interferometer (1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer.	**05** **10**
2	**2.Diffraction, Fresnel Diffraction, Fraunhofer Diffraction:** **2.1 Diffraction:** Kirchhoff's integral theorem, Fresnel-Kirchhoff's integral formula. (Qualitative discussion only) **2.2 Fresnel Diffraction:** Fresnel's assumptions. Fresnel's half-period zones for plane wave, Explanation of rectilinear propagation of light, Fresnel's integral, Fresnel diffraction pattern of a straight edge, a slit and cylindrical obstacle. **2.3 Fraunhofer Diffraction:** Single slit, Circular aperture, Double slit, Multiple slits, Diffraction grating.	 **02** **07** **06**
3	**3. Polarization, Resolving Power, LASER :** **3.1 Polarization:** Description of linear, circular, and elliptical polarization, Propagation of electromagnetic waves in anisotropic media, Uniaxial and biaxial crystals, Light propagation in uniaxial crystal, Double refraction, Polarization by double refraction, Nicol prism, Ordinary and extraordinary refractive indices, Production, and detection of plane, circularly and elliptically polarized light, Phase retardation plates: quarter wave and half wave plates **3.2 Resolving Power:** Resolving Power of Prism, Resolving Power of Grating, Resolving Power of Telescope **3.3 LASER:**	 **08** **03** **04**

	Einstein's A and B coefficients, Metastable states, Spontaneous and stimulated emissions, Optical Pumping and population inversion, Principle of Laser, Properties of Laser, Ruby Laser and He-Ne Laser.	

Self-Learning topics (Unit wise)

Unit	Topics
I	Definition and properties of wave front, Huygens Principle, Temporal and Spatial Coherence.
II	Kirchhoff's Integral Theorem, Fresnel-Kirchhoff's Integral formula. (Qualitative discussion only)
III	Resolving Power of Grating, Resolving Power of Telescope.

Online Resources

Reference:- http// nptel.ac.in

Reference Books:

1. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
2. Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
3. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
4. Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications.
5. Principles of Optics, B.K. Mathur and T.P. Pandya, 1990, Kanpur Gopal Printing Press.
6. A Textbook of Optics, Dr. N. Subrahmanyam, Brij Lal and Dr. M.N. Avadhanulu, 2012, S. Chand Publications.

Course Name: Thermal Physics
Course Code: US - SPH – 402

Learning Outcomes:

- Comprehend the basic concepts of thermodynamics, the first and the second law of thermodynamics.
- Learn about Maxwell-Boltzmann distribution law, equitation of energies, and mean free path of molecular collisions, viscosity, thermal conductivity, diffusion and Brownian motion.
- Learn about the real gas equations, Van der Waal equation of state, and the Joule-Thompson effect.

Unit	Content	No. of Lectures
1	**1 Velocity Distribution in an ideal gas, Molecular Collisions in Ideal gas:** **1.1 Velocity Distribution in an Ideal Gas:** Maxwell-Boltzmann law of distribution of velocities in an ideal gas and its experimental verification, Doppler broadening of spectral lines and Stern's experiment, Mean, rms and most probable speeds, Degrees of freedom, Law of equipartition of energy (No proof required), Specific heats of gases. **1.2 Molecular Collisions in an Ideal Gas:**	**10** **05**

	Mean free path, Collision probability, Estimate of mean free path, Transport phenomenon in ideal gases: (1) Viscosity, (2) Thermal conductivity and (3) Diffusion, Brownian motion and its significance	
2	**2 Real Gases:** Behavior of real gases: deviations from the ideal gas equation, The virial equation, Andrew's experiments on CO_2 gas, Critical constants, Continuity of liquid and gaseous state, Vapour and gas, Boyle Temperature, Van der Waal's equation of State for real gases, Values of critical constants, Law of corresponding states, Comparison with experimental curves, P-V Diagrams, Joule's experiment, Free adiabatic expansion of a perfect Gas, Joule-Thomson porous plug experiment, Joule-Thomson effect for Real and Van der Waal gases, Temperature of inversion, Joule-Thomson Cooling	**15**
3	**3 First Law of Thermodynamics, Second Law of Thermodynamics:** **3.1 First Law of Thermodynamics:** First Law of Thermodynamics and its differential form, Internal energy, first law & various processes, Applications of first law: general relation between C_P and C_V, Work done during isothermal and adiabatic processes, Compressibility and expansion co-efficient. **3.2 Second Law of Thermodynamics:** Reversible and irreversible process with examples. Conversion of work into heat and heat into work, Heat Engines, Carnot's cycle, Carnot engine & efficiency, Refrigerator & coefficient of performance, Second Law of thermodynamics: Kelvin-Planck and Clausius Statements and their equivalence, Carnot's theorem. Applications of second law of thermodynamics: thermodynamic scale of temperature and its equivalence to perfect gas scale.	**05** **10**

Self-Learning topics (Unit wise)

Unit	Topics
I	Maxwell-Boltzmann law of distribution of velocities in an ideal gas.
II	Behavior of real gases: deviations from the ideal gas equation.
III	First law of thermodynamics and its differential form

Online Resources

Reference:- http// nptel.ac.in

Reference Books:

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
2. A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, 1958, Indian Press.
3. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill.
4. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
5. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger, 1988, Narosa.
6. Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford University Press.
7. Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. Chand Publications.

Course Name: Electronics 2

Course Code: US - SPH – 403

Learning Outcomes:

- Learn synthesis of Boolean functions, simplification, and construction of digital circuits by employing Boolean algebra
- Learn about 555 timer and its applications
- Learn about different types of feedback and oscillators
- Learn about operational amplifier, its different configurations, and applications

Unit	Content	No. of Lectures
1	**1. Boolean Algebra, Sequential Circuits:** **1.1 Boolean Algebra:** Boolean laws, Simplification of logic circuits using Boolean algebra, Fundamental products, Idea of minterms and maxterms, Conversion of truth table into equivalent logic circuit using (1) sum of product method, (2) Product of sum method, (3)Karnaugh map. **1.2 Sequential Circuits:** SR, D and JK flip-flops, Clocked (leveled and edge triggered) flip-flops, PRESET and CLEAR operations, Race around condition in JK flip-flop, M/S JK flip-flop.	**08** **07**
2	**2. Feedback in Amplifier, Sinusoidal Oscillator, Timer:** **2.1 Feedback in Amplifier:** Effect of positive and negative feedback on input impedance, output impedance, gain, stability, distortion, and noise **2.2 Sinusoidal Oscillator:** Barkhausen's criteria for self-sustained oscillations, R-C Phase Shift oscillator, determination of frequency, Colpitt's oscillator, Hartley's oscillator **2.2 Timer:** IC 555 Block diagram, Application of 555 timer: Astable multivibrator and monostable multivibrator, Ramp generator	**05** **05** **05**
3	**3 Operational amplifier (Black Box Approach) and its Applications:** Characteristics of an ideal and practical OPAMP (IC 741), Open-loop and closed-loop gain, CMRR, Concept of virtual ground, Inverting and non-inverting amplifiers, Applications of OPAMP: (1)Adder (2) Subtractor (3) Differentiator (4) Integrator (5) Comparator (6) Log amplifier (7) Wein bridge oscillator	**15**

Self-Learning topics (Unit wise)

Unit	Topics
I	PRESET and CLEAR operations, Race around condition in JK Flip-Flop, M/S JK Flip-Flops
II	555 Timer-Ramp generators
III	OPAMP- Subtractor, log amplifier

Online Resources

Reference:- http// nptel.ac.in

Reference Books:

1. Digital Principles and Applications, A.P. Malvino, D.P. Leach and Saha, 7th edition 2011, Tata McGraw
2. Fundamentals of Digital Circuits, Anand Kumar, 2nd edition, 2009, PHI Learning Pvt. Ltd
3. Digital Circuits and system, Venugopal, 2011,Tata McGraw Hill
4. Digital Electronics, J.K.Kharate, 2010, Oxford University Press
5. Digital systems: Principles and Applications, R.J. Tocci, N.S.Widmer, 2001, PHI Learning
6. Logic Circuit Design, Shimon P. Vingron, 2012, Springer
7. Modern Digital Electronics, R.P. Jain, 4th edition, Tata McGraw Hill
8. Digital Computer Electronics, A.P. Malvino and J.A. Brown, McGraw Hill Education
9. Digital Electronics, Subrata Ghoshal, 2012,Cengage Learning
10. Digital Electronics, S.K. Mandal, 2010 1st edition, Tata McGraw Hill
11. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata McGraw Hill
12. Electronics: Fundamentals and applications, J.D.Ryder, 2004,Prentice Hall
13. Solid state Electronic Devices, B.G. Streetman and B.G. Banerjee, 6th edition, 2009 PHI Learning
14. Electronic Devices and circuits, S. Salivahanan, N.S. Kumar, 3rd edition, 2012, Tata Mc-Graw Hill.
15. Electronic circuits: Handbook of design and applications, U. Tietze, C. Schenk, 2008, Springer
16. Semiconductor Devices: Physics and Technology, S.M. Sze, 2nd edition, 2002, Wiley India
17. Operational Amplifiers and Linear integrated circuits, R.F.Coughlin and F. Driscoll, 2000,Pearson
18. OP-AMP and Linear Digital circuits, Ramakant Gayakwad, 2000, PHI Pvt. Ltd.
19. Electronic Devices and Circuits, Allen Mottershead, Prentice Hall.

Course Name: Practical Course 4
(Practical based on US-SPH-401, US-SPH-402 & US – SPH - 403)
Course Code: US-SPH- P4

Learning Outcomes:

- In the laboratory course, student will gain hands-on experience of using various optical instruments and making finer measurements of wavelength of light using Newton Rings experiment, Fresnel Biprism etc.
- Resolving power of optical equipment can be learnt firsthand.

CONTENTS	No. of Lectures
<u>Section I (Practical based on US-SPH-401)</u> 1. Familiarization with: Schuster`s focusing; determination of angle of prism, and angle of minimum deviation 2. Cauchy constants of the material of a prism using mercury source. 3. To determine the wavelength of sodium source using Michelson's interferometer. 4. To determine wavelength of sodium light using Fresnel Biprism. 5. To determine wavelength of sodium light using Newton's Rings. 6. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating. **<u>Section II (Practical based on US-SPH-402)</u>**	3 lectures per batch 3 lectures per Experiment

1. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method. 2. To determine the Temperature Coefficient of Resistance by Platinum Resistance / Thermistor 3. Stefan's Law 4. Determination of Joule's constant. 5. To study constant pressure / volume air thermometer. **<u>Section III (Practical based on US-SPH-403)</u>** 1. OPAMP- Non-inverting amplifier and Voltage follower 2. OPAMP- Inverting amplifier and Difference Amplifier 3. OPAMP- Comparator. 4. OPAMP-Integrator and Differentiator 5. OPAMP-Wein Bridge Oscillator 6. 555 Timer as Astable Multivibrator with different Duty Cycles	

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal.
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.
5. Modern Digital Electronics, R.P. Jain, 4th edition, Tata McGraw Hill
6. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Milller (1994), Mc-Graw Hill
7. Electronic Principles, A.P. Malvino, Tata McGraw Hill
8. Electronic Devices and Circuit Theory, R.L. Boylestad & L.D. Nashelsky, 2009,Pearson

Note:

1. A minimum of 3 experiments must be performed from each section and reported in the journal.
2. The certified journal must contain a minimum of 12 experiments.
3. A separate index for each section is a must in the journal.
4. A certificate of completion of the Practical course is a must.

Scheme of Examination

Modality of Examination:

A) Internal Assessment:
B) Semester End Examination:

i) Theory Assessment:
ii) Practical Assessment:
A candidate will be allowed to appear for the Practical Examination of the Semester only if he submits a certified journal or a certificate from the Head of Department to the effect that he has completed the Practical Course of that semester of SYBSc with the minimum required experiments.
The Learner will have to appear for Practical Examination in each section of the Practical Course as per the below particulars:

Section	Particulars	Max Marks Allotted
I	Experiment	40
	Journal	05
	Viva	05
	Total	50
II	Experiment	40
	Journal	05
	Viva	05
	Total	50
III	Experiment	40
	Journal	05
	Viva	05
	Total	50
Grand Total of Section I, II, III		150