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ಸಂ.ಗುವಿಕ/ವಿಮವಿ/ಬಿ.ಓಎಸ್/2018–19/752 ದಿನಾಂಕ: 10-7-2018

ಅಧಿಸೂಚನೆ

ವಿಷಯ: ಬಿ.ಎಸ್ಸಿ ಭೌತಶಾಸ್ತ್ರ ಕೋರ್ಸಿಗಾಗಿ ಸಿಬಿಸಿಎಸ್ ಪದ್ಧತಿಯನ್ನು ಅಳವಡಿಸಿಕೊಂಡು ಅದಕ್ಕನುಗುಣವಾಗಿ ಪಠ್ಯಕ್ರಮವನ್ನು ಜಾರಿಗೊಳಿಸಿದ ಬಗ್ಗೆ.

ಉಲ್ಲೇಖ: 1) ಸ್ನಾತಕ ಅಧ್ಯಯನ ಮಂಡಳಿಯ ಸಭೆಯ ದಿನಾಂಕ: 09.06.2018
2) ವಿಜ್ಞಾನ ಮತ್ತು ತಂತ್ರಜ್ಞಾನ ನಿಕಾಯದ ಸಭೆ ದಿನಾಂಕ: 14.06.2018.
3) ವಿದ್ಯಾವಿಷಯಕ ಪರಿಷತ್ ಸಭೆಯ ಗೊತ್ತುವಳಿ ಸಂಖ್ಯೆ 11 ದಿನಾಂಕ.26.06.2018.

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ಉಲ್ಲೇಖ (3) ರಲ್ಲಿನ ವಿದ್ಯಾವಿಷಯಕ ಪರಿಷತ್‌ನ ಸಭೆಯ ಗೊತ್ತುವಳಿ ಸಂಖ್ಯೆ 11 ನ್ನು ಅನುಷ್ಠಾನಗೊಳಿಸುತ್ತ; ಬಿ.ಎಸ್ಸಿ ಭೌತಶಾಸ್ತ್ರ I ರಿಂದ VIನೇ ಸೆಮೆಸ್ಟರ ಪಠ್ಯಕ್ರಮವನ್ನು ಅಧ್ಯಯನ ಮಂಡಳಿಯು ಪರಿಷ್ಕರಿಸಿ ಅನುಮೋದಿಸಿರುತ್ತದೆ. ದಿನಾಂಕ 14.06.2018. ರಂದು ಜರುಗಿದ ವಿಜ್ಞಾನ ಮತ್ತು ತಂತ್ರಜ್ಞಾನ ನಿಕಾಯದ ಸಭೆಯಲ್ಲಿ ಸದರಿ ಪಠ್ಯಕ್ರಮವನ್ನು 2018–19ನೇ ಸಾಲಿನಿಂದ ಅನ್ವಯವಾಗುವಂತೆ ಜಾರಿಗೊಳಿಸಲು ಶಿಫಾರಸ್ಸು ಮಾಡಲಾಗಿದೆ.

ಅದರಂತೆ, 2018–19ನೇ ಸಾಲಿನಿಂದ ಅನ್ವಯವಾಗುವಂತೆ ಬಿ.ಎಸ್ಸಿ ಭೌತಶಾಸ್ತ್ರ ಸ್ನಾತಕ ಕೋರ್ಸಿನ I ರಿಂದ VIನೇ ಸೆಮೆಸ್ಟರ ಪಠ್ಯಕ್ರಮವನ್ನು ಪರಿಷ್ಕರಿಸಿ ಜಾರಿಗೊಳಿಸಲಾಗಿದೆ.

ಈ ಮಾಹಿತಿಯನ್ನು ಸಂಬಂಧಪಟ್ಟ ಶಿಕ್ಷಕರ ಹಾಗೂ ವಿದ್ಯಾರ್ಥಿಗಳ ಗಮನಕ್ಕೆ ತರಲು ಸೂಚಿಸಲಾಗಿದೆ. ಪಠ್ಯಕ್ರಮದ ವಿವರವನ್ನು ಗುಲಬರ್ಗಾ ವಿಶ್ವವಿದ್ಯಾಲಯದ ವೆಬ್‌ಸೈಟ್ www.gug.ac.in ದಿಂದ ಪಡೆಯಬಹುದು.

ಕುಲಸಚಿವರು
ಗುಲಬರ್ಗಾ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಕಲಬುರಗಿ

ಗೆ,

1. ಮುಖ್ಯಸ್ಥರು, ಭೌತಶಾಸ್ತ್ರ ಅಧ್ಯಯನ ವಿಭಾಗ, ಗು.ವಿ.ಕಲಬುರಗಿ.
2. ಎಲ್ಲಾ ಪದವಿ ಮಹಾವಿದ್ಯಾಲಯಗಳ ಪ್ರಾಂಶುಪಾಲರಿಗೆ.

ಪ್ರತಿಗಳು:

1. ಡೀನ್‌ರು, ವಿಜ್ಞಾನ ಮತ್ತು ತಂತ್ರಜ್ಞಾನ್ತ್ರ ನಿಕಾಯ, ಗು.ವಿ.ಕಲಬುರಗಿ ರವರ ಮಾಹಿತಿಗಾಗಿ.
2. ಕುಲಸಚಿವರು (ಮೌಲ್ಯಮಾಪನ), ಗುಲಬರ್ಗಾ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಕಲಬುರಗಿ ರವರ ಮಾಹಿತಿಗಾಗಿ.
3. ನಿರ್ದೇಶಕರು, ಯೋಜನೆ, ಮೇಲ್ವಿಚಾರಣೆ ಹಾಗೂ ಮೌಲ್ಯಮಾಪನ ಮಂಡಳಿ, ಗು.ವಿ.ಕಲಬುರಗಿ.
4. ಗ್ರಂಥಪಾಲಕರು, ಗು.ವಿ.ಕಲಬುರಗಿ ರವರ ಮಾಹಿತಿಗಾಗಿ.
5. ವಿಜ್ಞಾನ ಮತ್ತು ತಂತ್ರಜ್ಞಾನ್ತ್ರ ನಿಕಾಯದ ಎಲ್ಲಾ ವಿಭಾಗಗಳ ಮುಖ್ಯಸ್ಥರಿಗೆ.
6. ಮುಖ್ಯಸ್ಥರು, ಗಣಕಕೇಂದ್ರ, ಗು.ವಿ.ಕಲಬುರಗಿ ಇವರಿಗೆ ಸದರಿ ಪಠ್ಯಕ್ರಮವನ್ನು ವಿಶ್ವವಿದ್ಯಾಲಯದ ವೆಬ್ ಸೈಟ್ ನಲ್ಲಿ ಪ್ರಕಟಿಸಲು ತಿಳಿಸಲಾಗಿದೆ.
7. ಕುಲಪತಿಗಳ ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿ / ಕುಲಸಚಿವರ ಆಪ್ತ ಸಹಾಯಕರ ಮಾಹಿತಿಗಾಗಿ.

ENCLOSER TO THE
ITEM No.[11]

GULBARGA UNIVERSITY KALABURAGI

CHOICE BASED CREDIT SYSTEM

B SC PHYSICS [CBCS] SYLLABUS

[SEMESTER SCHEME]

BOS Resolution No.1, dated 9-6-2018

EFFECTIVE FROM THE ACADEMIC YEAR 2018-19

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Distribution of Courses/Papers in Under Graduate Program I to VI Semester as per Choice Based Credit System (CBCS) for the degree in B.Sc. Courses

Semester	Course Code	Course Type	Course Title	Credits	Teaching per week L:T:P	Total Credits
	Semester					
I	11	AECC-1a		3		
	12	AECC-1b		3		
	13	AECC-1c		2		
	14	DSC1-PHY104T DSC1-PHY104P	Mechanics Mechanics Practical -I	4 2	4:0:2	26
	15	DSC 2A		6		
	16	DSC 3A		6		
II	21	AECC-2a		3		
	22	AECC-2b		3		
	23	AECC-2c		2		
	24	DSC2-PHY204T DSC2-PHY204P	Electricity and Magnetism Electricity and Magnetism Practical -II	4 2	4:0:2	26
	25	DSC 2B		6		
	26	DSC 3B		6		
III	31	AECC-3a		3		
	32	AECC-3b		3		
	33	DSC3-PHY303T DSC3-PHY303P	Thermal Physics and Statistical Mechanics Thermal Physics & Statistical Mechanics Practical -III	4 2	4:0:2	24
	34	DSC 2C		6		
	35	DSC 3C		6		
IV	41	AECC-4a		3		
	42	AECC-4b		3		
	43	DSC4-PHY403T DSC4-PHY403P	Waves and Optics Waves and Optics Practical -IV	4 2	4:0:2	24
	44	DSC 2D		6		
	45	DSC 3D		6		
V	51	SEC1-PHY501T SEC1-PHY501P	Physics Workshop Skill Physics Workshop Skill - Lab	1 1	1:0:1	
	52	SEC2-PHY502T SEC2-PHY502P	Basic Instrumentation Basic Instrumentation - Lab or Project	1 1	1:0:1	
	53	DSE1-PHY503T1 DSE1-PHY503P1 DSE1-PHY503T2 DSE1-PHY503P2	i) Quantum Mechanics ii) Quantum Mechanics Practical-V i) Solid State Physics ii) Solid State Physics Practical -V	4 2	4:0:2	22
	54	DSE 2		6		
	55	DSE 3		6		
VI	61	SEC3-PHY601T SEC3-PHY601P	Radiation Safety Radiation Safety - Lab	1 1	1:0:1	
	62	SEC4-PHY602T SEC4-PHY602P	Renewable Energy and Energy Harvesting Renewable Energy & Energy Harvesting - Lab	1 1	1:0:1	
	63	DSE4-PHY603T1 DSE4-PHY603P1 DSE4-PHY603T2 DSE4-PHY603P2	i) Nuclear and Particle Physics ii) Nuclear and Particle Physics Practical-VI i) Medical Physics ii) Medical Physics Practical-VI	4 2	4:0:2	22
	64	DSE 5		6		
	65	DSE 6		6		
				Total credits for the course		144

Note: Course = paper: AECC: Ability Enhancement Course, MIL: Media and Information Literacy.
DSC: Discipline Specific Core Course, PHY: Physics
SEC: Skill Enhancement Course,
DSE: Discipline Specific Elective,
L=Lecture, T=Tutorial, P=Practical, Additional 02 credits shall be given for the successfully completion of two years of NSS (1st - 2nd) / NCC AECC-1c and AECC-2c papers shall be approved by the BOS of environmental science and political science. Tutorial/batch - 20 students practical/batch 10 students. AECC-a and AECC-b papers cover communicative skill.

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GULBARGA UNIVERSITY, KALABURAGI

The Course structure offered for B.Sc. Course with Physics as per CBCS at Gulbarga University, Kalaburagi effective from the academic year 2018-19.

Semester	Course	Course code	Course title	Credits L+P	Teaching hours/week L+P=Total
I	Core courses	DSC1-PHY104T DSC1-PHY104P	Mechanics Mechanics Practical -I	4+2=6	4+2=6
II		DSC2-PHY204T DSC2-PHY204P	Electricity and Magnetism Electricity and Magnetism Practical-II	4+2=6	4+2=6
III		DSC3-PHY303T DSC3-PHY303P	Thermal Physics and Statistical Mechanics Thermal Physics and Statistical Mechanics Practical -III	4+2=6	4+2=6
IV		DSC4-PHY403T DSC4-PHY403P	Waves and Optics Waves and Optics Practical-IV	4+2=6	4+2=6
V	Skill Enhancement courses	SEC1-PHY501T SEC1-PHY501P	Physics Workshop Skills Physics Workshop Skills-LAB	1+1=2	1+1=2
		SEC2-PHY502T SEC2-PHY502P	Basic Instrumentation Skills Basic Instrumentation Skills-LAB/Project	1+1=2	1+1=2
	Discipline Specific Elective Course	DSE1-PHY503T1 DSE1-PHY503P1 DSE1-PHY503T2 DSE1-PHY503P2	Quantum Mechanics Quantum Mechanics Practical-V Solid State Physics Solid State Physics Practical -V	4+2=6	4+2=6 6+4=10
VI	Skill Enhancement Courses	SEC3-PHY601T SEC3-PHY601P	Radiation Safety Radiation safety -LAB	1+1=2	1+1=2
		SEC4-PHY602T SEC4-PHY602P	Renewable Energy and Harvesting Renewable Energy and Harvesting -LAB	1+1=2	1+1=2
	Discipline Specific Elective Course	DSE4-PHY603T1 DSE4-PHY603P1 DSE4-PHY603T2 DSE4-PHY603P2	Nuclear and Particle Physics Nuclear Physics Practical -VI Medical Physics Medical Physics Practical -VI	4+2=6	4+2=6 6+4=10
			Total credits for Physics Courses	**44**	

L: Lecture, P: Practical

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B.Sc Physics (CBCS) Syllabus (Semester Scheme): Effective from 2018-2019

Teaching and Evaluation Scheme

Sem	Title of the Paper	Credits	Semester End Examination Duration	Max. Marks	Internal Assessment Duration	Max. marks	Total Max. marks
I	DSC1-PHY104T: Mechanics	4	3hrs	80	1hr	20	100
	DSC1-PHY104P: Mechanics Practical-I	2	3hrs	40	3hrs	10	50
II	DSC2-PHY204T: Electricity and Magnetism	4	3hrs	80	1hr	20	100
	DSC2-PHY204P: Electricity and Magnetism Practical-II	2	3hrs	40	3hrs	10	50
III	DSC3-PHY303T: Thermal Physics and Statistical Mechanics	4	3hrs	80	1hr	20	100
	DSC3-PHY303P: Thermal Physics and Statistical Mechanics Practical-III	2	3hrs	40	3hrs	10	50
IV	DSC4-PHY403T: Waves and Optics	4	3hrs	80	1hr	20	100
	DSC4-PHY403P: Waves and Optics Practical-IV	2	3hrs	40	3hrs	10	50
V	SEC1-PHY501T: Physics Workshop Skills	1	1.5hrs	40	1hr	10	50
	SEC1-PHY501P: Physics Workshop Skills-LAB	1		--		--	
	SEC2-PHY502T: Basic Instrumentation Skills	1	1.5hrs	40	3hrs	10	50
	SEC2-PHY502P: Basic Instrumentation Skills-LAB/Project	1		--		--	
	DSE1-PHY503T1: Quantum Mechanics	4	3hrs	80	1hr	20	100
	DSE1-PHY503T2: Solid State Physics						
	DSE1-PHY503P1: Quantum Mechanics Practical-V	2	3hrs	40	3hrs	10	50
	DSE1-PHY503P2: Solid State Physics Practical-V						
VI	SEC3-PHY601T: Radiation Safety	1	1.5hrs	40	1hr	10	50
	SEC3-PHY601P: Radiation Safety-LAB	1		--		--	
	SEC4-PHY602T: Renewable Energy & Energy Harvesting	1	1.5hrs	40	1hr	10	50
	SEC4-PHY602P: Renewable Energy & Energy Harvesting LAB	1		--		--	
	DSE4-PHY603T1: Nuclear and Particle Physics	4	3hrs	80	1hr	20	100
	DSE4-PHY603T2: Medical Physics						
	DSE4-PHY603P1: Nuclear and Particle Physics Practical-VI	2	3hrs	40	3hrs	10	50
	DSE4-PHY603P2: Medical Physics Practical-VI						

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QUESTION PAPER PATTERN FOR A TESTS AND SEMESTER AND EXAMINATIONS.

1. INTERNAL ASSESSMENT TEST

a) Internal Assessment Test 1 for theory courses

There shall be three questions for ten marks each. Students will have to answer two questions.

Questions must be drawn from the first half of the syllabus of the paper giving due weight-age to each of the chapters based on the instructional hours allotted to it.

Duration of the test is one hour. Maximum marks 20.

b) Internal Assessment test 2 for theory courses.

There shall be three questions for ten marks each. Students will have to answer two questions.

Questions must be drawn from the first half of the syllabus of the paper giving due weight-age to each of the chapters based on the instructional hours allotted to it.

Duration of the test is one hour. Maximum marks 20.

Notice: Average of the marks secured in two internal assessment tests will be taken as the final awarded marks in the internal assessment test of the respective theory paper.

c) Practical Internal Assessment test

There shall be one internal assessment test in each of the practical courses. In the practical test, the students may be asked to perform the experiment or analyze the given experimental data.

Duration of the practical test is 3 hours. Maximum marks 10.

2. a) SEMESTER END EXAMINATIONS.

Question paper pattern for theory courses (DSC and DSE).

There shall be three sections, I, II and III in the question paper.

In section I, there shall be 12 questions of 2 marks each; students will answer any 10 questions.
In section II, there shall be 6 questions of 5 marks each; students will answer any four questions.
In section III, there shall be 6 questions of 10 marks each; students will answer any four questions.

In case of 40 marks paper (SECs) the question paper pattern is reduced to half of the above mentioned.
Incase of Project: Dissertation: 30 marks, Viva: 10, I.A: 10
Questions must be drawn from the total syllabus of the paper giving due weight-age to each of the chapters based on the instructional hours allotted to it.

Examination will be conducted for 3 hours for maximum of 80 marks.

b) **Question paper pattern for practical courses**
In the semester end practical examination, there shall be one experiment assigned (picked by the student from the list of the experiments put for the examinations) to each of the students. It will be examined for 40 marks. Distribution of marks for various components in the practical examination is mentioned under scheme of examination.

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Department of Physics
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Model Question paper for theory examination for DSC and DSE papers

B Sc I-Semester Degree [CBCS] Examination November, 2018.

Paper:DSC1-PHY104T: Mechanics

Time: 3 h Max. Marks: 80

Instruction to Candidates: 1. Answer all the questions.
2. Draw diagrams wherever necessary

I. Answer any TEN of the following in two or three sentences (2x10=20)

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.

II. Answer any FOUR of the following (4x5=20)

13.
14
15
16
17
18

III. Answer any FOUR of the following (4x10=40)

19
20
21
22
23
24

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LABORATORY INSTRUCTIONS TO STUDENTS

1. Measurements and results must be written in SI system only.
2. Required number of experiments in each semester must be performed in order to be eligible for taking semester end examination.
3. After completing all the experiments in the given semester and writing up the Journal students have to get certify their Journal by the Head of the Department. The same must be produced in the examination for assessment.

SCHEME OF PRACTICAL EXAMINATIONS.

Division of marks in practical IA and Practical semester end examinations is detailed below.

Internal Practical Test			**Semester End Practical Examination**		
No.	Item	Max.marks	No.	Item	Max.marks
1	Journal	02	1	Journal	08
2	Circuit diagram / ray diagram/ observations	02	2	Circuit diagram / ray diagram/ observations	08
3	Observations/ Tabular column	02	3	Observations/ Tabular column	08
4	Experimental skill & procedure	02	4	Experimental skill & procedure	08
5	Graph/calculation/result	02	5	Graph/calculation/result	08
	Total	10		Total	40

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I-SEMESTER
PHYSICS
DSC1-PHY104T: MECHANICS
(Credits: Theory-04) 60 Lectures

UINT-1

Laws of Motion: Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass. (10 Lectures)

UNIT-2

Momentum and Energy: Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets. (6 Lectures)

Rotational Motion: Angular velocity and angular momentum. Torque. Conservation of angular momentum. (5 Lectures)

UNIT-3

Dynamics of Rigid bodies: Rotational motion about an axis, Angular momentum, Relation between torque and angular momentum, Rotational energy. Theorem: Perpendicular and Parallel axis. Examples of moment of Inertia: M.I. of a Lamina, M.I. of Disc, M.I. of a Circular ring, M.I. Solid and Hallow Cylinders. Flywheel; Problems. Theory of compound pendulum and determination of g by compound pendulum. (10 Lectures)

UNIT-4

Gravitation: Newton's Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's Laws (statement only). Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS). (8 Lectures)

UNIT-5

Elasticity: Hooke's law - Stress-strain diagram - Elastic moduli-Relation between elastic constants - Poisson's Ratio-Expression for Poisson's ratio in terms of elastic constants - Work done in stretching and work done in twisting a wire - Twisting couple on a cylinder - Determination of Rigidity modulus by static torsion – Torsional pendulum-Determination of Rigidity modulus and moment of inertia - q, η and σ by Searles method. (8 Lectures)

UNIT-6

Oscillations: Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped oscillations. (6 Lectures)

Special Theory of Relativity: Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities. (7 Lectures)

Reference Books:

- University Physics, F W Sears, M W Zemansky and H D Young,13th Edn, 1986, Addision Wesley.
- Mechanics Berkeley Physics Course, Vol.1:Charles Kittel, *et.al.* 2007, Tata McGraw-Hill.
- Physics: Resnick, Halliday & Walter, 9th Edn, 2010, Wiley.
- Engineering Mechanics, Basudeb Bhattacharya, 2nd Edn, 2015, Oxford University Press.
- University Physics, Ronald Lane Reese, 2003, Thamson Brooks/Cole.

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DSC1-PHY104P: MECHANICS-PRACTICAL-I
(Credits: Practicals-02) 60 Lectures

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
2. To determine the Height of a Building using a Sextant.
3. To determine the Moment of Inertia of a Flywheel.
4. To determine the Young's Modulus of a Wire by bar bending method.
5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
6. To determine the Elastic Constants of a Wire by Searle's method.
7. To determine g by Bar Pendulum (L vs T and L^2 Vs LT^2).
8. To determine g by Kater's Pendulum.
9. Verification of Parallel axis theorem.
10. To determine g and velocity for a freely falling body using Digital Timing Technique
11. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of g.
12. Verification of Perpendicular axis theorem.
13. Moment of Inertia of irregular body.
14. Young's modulus by cantilever- load versus Depression graph.
15. Assignment-I
16. Assignment-II
17. Assignment-III
18. Assignment-IV
19. Assignment-V

Reference Books:

- Advanced Practical Physics for students, B.L.Flint and H.T.Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
- Engineering Practical Physics, S. Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

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II-SEMESTER
PHYSICS
DSC2-PHY204T: ELECTRICITY AND MAGNETISM

(Credits: Theory-04) 60 Lectures

UNIT-1

Vector Analysis: Review of vector algebra (Scalar and Vector product), gradient, divergence, Curl and their significance,Qualitative approach on Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors (statement only). (5 Lectures)

Electrostatics: Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere,. Electric potential as line integral of electric field, potential due to a point charge, Capacitance of an isolated spherical conductor. Parallel plate and spherical condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric.

(10 Lectures)

UNIT-2

Magnetism: Magnetostatics: Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law. (5 Lectures)

Magnetic Field and Force: Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para- and ferro-magnetic materials. (5 Lectures)

UNIT-3

Electromagnetic Induction: Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic field. (5 Lectures)

UNIT-4

Magnetic properties of Materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility, explanation of magnetic materials, paramagnetic susceptibility-Curie law, Hysteresis loss of energy. (5 Lectures)

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

(10 Lectures)

UNIT-5

DC Circuit analysis: Concept of current and voltage sources, Kirchoff's Current and Voltage law. Principle of Duality (voltage and Current sources equivalents).Thevenin's theorem, Superposition theorem, Reciprocity theorem and Maximum Power transfer theorem (5 Lectures)

Transient currents: Growth and decay of charge in RC circuit, Growth and decay of current in series LR circuit, decay of charge in series LCR circuit. (3 Lectures)

UNIT-6

Alternating currents: Review of basic definitions, LCR Series circuit to sinusoidal voltages. impedance by using only j operators -series resonance, Q factor and bandwidth- qualitative explanation of LCR parallel circuit. (7 Lectures)

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Reference Books:

- Electricity and Magnetism, Edward M. Purcell, 1986, McGraw Hill Education.
- Electricity and Magnetism, J.H. Fewkes & J. Yarwood, Vol.1, 1991, Oxford Uni. Press.
- Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
- Introduction to Electrodynamics, D J Griffiths, 3rd Edn, 1998, Benjamin Cummings.
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
- Electric networks by B,L Theraja
- Electricity and Magnetism K K Tiwari.
- Electricity and Magnetism by Brij Lal and N Subrahmanyam.
- Electricity and Magnetism by Khare and Srivastava.

DSC2-PHY104P : ELECTRICITY AND MAGNETISM- PRACTICAL-II

(Credits: Practical -2) 60 Lectures

1. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, and (d) checking electrical fuses.
2. Ballistic Galvanometer: Pointer galvanometer /Spot galvanometer
   - (i) Measurement of charge and current sensitivity
   - (ii) Measurement of CDR
   - (iii) Determine a high resistance by Leakage Method
   - (iv) To determine Self Inductance of a Coil by Rayleigh's Method.
3. To compare capacitances using De'Sauty's bridge.
4. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx).
5. To study the Characteristics of a Series RC Circuit.
6. To study the a series LCR circuit and determine its (a) Resonant Frequency (b) Quality Factor.
7. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor.
8. To determine a Low Resistance by Carey Foster's Bridge
9. To verify the Thevenin and Norton theorem.
10. To verify the Superposition, and Maximum Power Transfer Theorem.
11. To determine Self- inductance of a given coil by using Anderson 's bridge
12. To determine L for two different values by equal voltage method.
13. To determine C for two different values by equal voltage method.
14. Verification of Faraday's laws.
15. Earth Inductor.
16. Study Gobar gas Plant.

Reference Books:

- Advanced Practical Physics for students, B. L. Flint & H.T.Worsnop, 1971, Asia Publishing House.
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
- Engineering Practical Physics, S. Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985 Heinemann Educational Publishers.

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III-SEMESTER
PHYSICS
DSC3-PHY303T: THERMAL PHYSICS AND STATISTICAL MECHANICS
(Credits: Theory-04) 60 Lectures

UNIT-1

Laws of Thermodynamics: Thermodynamic Description of system: Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work. Various Thermodynamical Processes, Applications of First Law: General Relation between CP & CV, Work Done during Isothermal and Adiabatic Processes, Compressibility & Expansion Coefficient, Reversible & irreversible processes, Second law & Entropy, Carnot's cycle & theorem. (15 Lectures)

UNIT-2

Thermodynamic Potentials: Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations & applications - Joule-Thompson Effect, Clausius Clapeyron Equation, Expression for (CP – CV), CP/CV, TdS equations. Refrigerator, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero. (15 Lectures)

UNIT-3

Kinetic Theory of Gases: Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order),

Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases. (9 Lectures)

UNIT-4

Theory of Radiation: Blackbody radiation, Spectral distribution, Concept of Energy Density. Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh- Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law. (6 Lectures)

UNIT-5

Statistical Mechanics: Phase space, Macrostate and Microstate, Entropy and Thermodynamic probability, Statistical equilibrium, Maxwell-Boltzmann distribution law - distribution of velocity mean, RMS and most probable velocities - Quantum statistics - Fermi-Dirac distribution law - electron gas - Bose-Einstein distribution law - photon gas - comparison of three statistics. (15 Lectures)

Reference Books:

- Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
- A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1969, Indian Press.
- Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications.
- Heat and Thermodynamics, M.W.Zemasky and R. Dittman, 1981, McGraw Hill 14
- Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W.Sears & G.L.Salinger. 1988, Narosa
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
- Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. chand Publications.
- Heat and Thermodynamics by Brijlal and Subramanyam.
- Heat Thermodynamics and Statistical physics by Singhal, Agrwal and Singhal.

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DSC3-PHY303P: THERMAL PHYSICS AND STATISTICAL MECHANICS PRACTICAL-III
(Credits: Practical-2) 60 Lectures

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. Measurement of Planck's constant using black body radiation.
3. To determine Stefan's Constant.
4. Verification of Stefan's T^4th Law.
5. To determine the coefficient of thermal conductivity of copper by Searle's Apparatus.
6. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
7. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
8. To determine the temperature co-efficient of resistance by Platinum resistance thermometer.
9. To study the variation of thermo emf across two junctions of a thermocouple with temperature.
10. To calibrate the given thermocouple and to determine the un known temperature
11. To record and analyze the cooling temperature of an hot object as a function of time using a thermocouple and suitable data acquisition system
12. To calibrate Resistance Temperature Device (RTD) using Null Method/Off-Balance Bridge.
13. Assignment-I
14. Assignment-II
15. Assignment-III
16. Assignment-IV
17. Assignment-V

Reference Books:

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

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IV- Semester
PHYSICS
DSC4-PHY403T: WAVES AND OPTICS
(Credits: Theory-04) 60 Lectures

UNIT-1

Superposition of Two Collinear Harmonic oscillations: Linearity and Superposition Principle. (1) Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats). (4 Lectures)

Superposition of Two Perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses. (2 Lectures)

Waves Motion- General: Transverse waves on a string. Travelling and standing waves on a string. Normal Modes of a string. Group velocity, Phase velocity. Plane waves. Spherical waves, Wave intensity. (7 Lectures)

UNIT-2

Fluids: Surface Tension: Synclastic and anticlastic surface - Excess of pressure - Application to spherical and cylindrical drops and bubbles - variation of surface tension with temperature - Jaegar's method. Viscosity: Viscosity - Rate flow of liquid in a capillary tube - Poiseuille's formula - Determination of coefficient of viscosity of a liquid - Variations of viscosity of a liquid with temperature lubrication. Physics of low pressure - production and measurement of low pressure - Rotary pump - Diffusion pump - Molecular pump - Knudsen absolute gauge - penning and pirani gauge – Detection of leakage. (6 Lectures)

UNIT-3

Sound: Simple harmonic motion - forced vibrations and resonance - Intensity and loudness of sound - Decibels - Intensity levels - musical notes - musical scale. Acoustics of buildings: Reverberation and time of reverberation - Absorption coefficient - Sabine's formula - measurement of reverberation time - Acoustic aspects of halls and auditoria. (6 Lectures)

Wave Optics: Electromagnetic nature of light. Definition and Properties of wave front. Huygens Principle. Construction of wave front. (3 Lectures)

UNIT-4

Interference: Interference: Division of amplitude and division of wavefront. Young's Double Slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: measurement of wavelength and refractive index. (10 Lectures)

UNIT-5

Michelson's Interferometer: Idea of form of fringes (no theory needed), Determination of wavelength, Wavelength difference, Refractive index and Visibility of fringes. (3 Lectures)

Diffraction: Fraunhofer diffraction: Single slit; Double Slit. Multiple slits or Diffraction grating. Fresnel Diffraction: Half-period zones. Zone plate. Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis. (6 Lectures)

UNIT-6

Polarization: Transverse nature of light waves. Plane polarized light – production and analysis. Circular and elliptical polarization. Double refraction in an uniaxial crystal, Huygens theory of positive and negative crystal, Optical activity: Fresnel theory , Quarter wave plate and Half wave plate, Laurent half shade polarimeter. (13 Lectures)

Reference Books:

- Fundamentals of Optics, F A Jenkins and H E White, 1976, McGraw-Hill
- Principles of Optics, B.K. Mathur, 1995, Gopal Printing
- Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, R. Chand Publication
- University Physics. FW Sears, MW Zemansky and HD Young 13/e, 1986 Addison-Wesley

DSC4-PHY403P: WAVES AND OPTICS PRACTICAL-IV
(Credits: Practical-02) 60 Lectures

1. To investigate the motion of coupled oscillators
2. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify λ^2 – T Law.
3. To study Lissajous Figures.
4. Familiarization with Schuster's focussing; determination of angle of prism.
5. To determine the Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
6. To determine the Refractive Index of the Material of a given Prism using Sodium Light.
7. To determine Dispersive Power of the Material of a given Prism using Mercury Light
8. To determine the value of Cauchy Constants of a material of a prism.
9. To determine the Resolving Power of a Prism.
10. To determine wavelength of sodium light using Fresnel Biprism.
11. To determine wavelength of sodium light using Newton's Rings.
12. To determine the wavelength of Laser light using Diffraction of Single Slit.
13. To determine wavelength of (1) Sodium & (2) spectrum of Mercury light using plane diffraction Grating.
14. To determine the Resolving Power of a Plane Diffraction Grating.
15. To measure the intensity using photosensor and laser in diffraction patterns of single and double slits.
16. Determination of grating constant using Laser.
17. Study of optical rotation for any system.

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Reference Books:

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

V- Semester
PHYSICS
SKILL ENHANCEMENT COURSE

SEC1-PHY501T: PHYSICS WORKSHOP SKILLS
(Credits: 02) 30 Lectures

UNIT-1

Introduction: Measuring units, conversion to SI and CGS, Familiarization with Glarks table, meter scale, vernier calliper, Screw guage, Travelling microscope, spectrometer and their utility. Measure the dimension of a solid block, volume of cylindrical beaker glass, diameter of a thin wire, thickness of metal sheet, etc. Use of Sextant to measure height of buildings, momentum etc. [4 Lectures]

UNIT-2

Mechanical skill: Concept of workshop practice. Overview of manufacturing methods, casting, foundry, machining, forming and welding. Types of welding joints and welding defects. Methods of analysing mechanical properties of materials like steel, copper, iron, metal sheets, composites and alloy. Concept of machine processing introduction to common machine tools like lathe, shaper, drilling, milling and surface machines. Cutting tools, lubricating oils. Cutting of a metal sheet using blade, smoothening of cutting edge of sheet using file. Drilling of holes of different diameter in metal sheet and wooden block. Use of bench vice and tools for fitting. Make funnel using metal sheet. [10 Lectures]

UNIT-3

Electrical and electronic skill: Use of multimeter, function generator, dual power supply, soldering of electrical circuits having discrete components (R, L, C, diode, transistor) IC s on PCB. Operation of oscilloscope. Making regulated power supply. Timer circuit. Electronic switch using transistor and relay. [10 Lectures]

UNIT-4

Introduction to prime movers: Mechanism, gear system, wheel, fixing of gear with motor axel lever mechanism, lifting of heavy weight using lever, braking systems, pulleys, working principle of power generation systems. Demonstration of pulley experiment. [6 Lectures]

Reference Books:

- A text book in Electrical Technology - B L Theraja – S. Chand and Company.
- Performance and design of AC machines – M.G. Say, ELBS Edn.
- Mechanical workshop practice, K.C. John, 2010, PHI Learning Pvt. Ltd.
- Workshop Processes, Practices and Materials, Bruce J Black 2005, 3rd Edn.,Editor Newnes [ISBN: 0750660732]
- New Engineering Technology, Lawrence Smyth/Liam Hennessy, The Educational Company of Ireland [ISBN: 0861674480]

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SEC1-PHY501P: PHYSICS WORKSHOP SKILLS- LAB

1. Use of vernier calliper, Screw guage and spherometer to measure diameter of objects.
2. Use of travelling microscope to measure slit width.
3. Measure the dimension of solid block, volume of cylindrical glass beaker.
4. Measure the diameter of a thin wire and thickness of metal sheet using screw gauge.
5. USe of sextant to measure height of buildings.
6. Mechanical properties of materials like steel copper, iron and metal sheets.
7. Welding for joints of iron rods.
8. Cutting of metal sheet using blade.
9. Drilling of holes of different diameters in metal sheet.
10. Drilling of holes of different diameters in wooden block.
11. Use of multimeter to find voltage, current and resistance.
12. Soldering of electrical circuits having discrete componenets (R, L, C, diode, Transistor etc)
13. Use and operation of oscilloscope.
14. Making regulated power supply.
15. Fixing of gear with motor axel lever mechanism.
16. Lifting of heavy weight using lever.
17. working principle of power generation systems.
18. Demonstration of pulley experiment.

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V-Semester
PHYSICS
SKILL ENHANCEMENT COURSE

SEC2-PHY502T: BASIC INSTRUMENTATION SKILLS
(Credits: 02) 30 Lectures

This course is to get exposure with various aspecis of instruments and their usage through hands-on mode. Experiments listed below are to be done in continuation of the topics.

UNIT-1

Basic of Measurement:
Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. **Multimeter:** Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance. (4 Lectures)

Signal Conditioning :
Need of signal conditioning, instrumentation using OP-Amp precision, Full wave rectifier using OP-Amp, active filter using OP-Amp, peak-detector, sample and hold circuits. (4 Lectures)

UNIT-2

Electronic Measuring Meters :
Principle and working with block diagram of electronic ac/dc voltmeter, AC/DC ammeter and ohm meter. Merits and demerits of electronic meters over conventional meters specifications. (4 Lectures)

Electronic Voltmeter:
AC mili-voltmeters block diagram and working principle, types of mili-voltmeters, amplifier rectifier and rectifier amplifier. Block diagram of ac mili-voltmeter specification and their significance. (3 Lectures)

UNIT-3

Digital Multimeter:
Block diagram and working of digital multimeter,working principle of time interval, frequency and period measurement using universal counter/frequency counter, time base stability accuracy and resolution. (4 Lectures)

Signal Generators and Analysis Instruments :
Block diagram, explanation and specifications of low frequency signal generators. Pulse generator and function generator. Brief idea for testing, specifications. Distortion factor meter, wave analysis. (3 Lectures)

Impedance Bridges and Q-Meters :
Block diagram of bridge. Working principles of basic(balancing type) RLC bridge. Specifications of RLC bridge. Block diagram and working principles of a Q-Meter. Digital LCR bridges. (3 Lectures)

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UNIT-4

Cathode Ray Oscilloscope :
Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only – no mathematical treatment), brief discussion on screen phosphor, visual persistence and chemical composition. Time base operation, synchronization. Front panel controls. Specifications of a CRO and their significance. Use of CRO for the measurement of voltage (dc and ac frequency, time period. Special features of dual trace. (3 Lectures)

Digital Storage Oscilloscope(DSO) :
Introduction to Digital Oscilloscope and advantages over conventional CRO, Block diagram and working principle. (2 Lectures)

SEC2-PHY502P: BASIC INSTRUMENTATION SKILLS – LAB

The test of lab skills will be of the following test items:

1. Use of an oscilloscope
2. CRO as a versatile measuring device.
3. Circuit tracing of Laboratory electronic equipment
4. Use of Digital multimeter/VTVM for measuring voltages
5. Circuit tracing of Laboratory electronic equipment
6. Winding a coil/transformer
7. Study the layout of receiver circuit.
8. Trouble shooting a circuit
9. Balancing of bridges.

Lab Experiments:

1. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.
2. To observe the limitations of a multimeter for measuring high frequency voltage and currents.
3. To measure Q of a coil and its dependence on frequency, using Q- meter.
4. Measurements of voltage, frequency, time period and phase angle using CRO.
5. Measurements of time period, frequency, average period using universal counter/frequency counter.
6. Measurements of rise, fall and delay times using a CRO.
7. Measurements of distortion of a RF signal generator using distortion factor meter.
8. Measurements of R, L and C using a LCR bridge/universal bridge.
9. Istrumention Amplifier using OP-Amp determination of Gain.
10. Decision Full- wave rectifier using OP-Amp/Input and output wave form.
11. Active Low pass Filter and High pass Filters to verify cut-off-frequency.
12. Construct peak detector using OP- Amp trace Input and output wave form.

Open Ended Experiments:

1. Using a Dual Trace Oscilloscope.
2. Converting the range of a given measuring instrument(voltmeter, ammeter)

Reference Books:

- A text book in Electrical Technology - B L Theraja - S Chand and Co.
- Performance and design of AC machines - M G Say ELBS Edn.
- Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
- Logic circuit design, Shimon P. Vingron, 2012, Springer.
- Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
- Electronic Devices and circuits, S. Salivahanan & N. S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill
- Electronic circuits: Handbook of design and applications, U.Tietze, Ch.Schenk, 2008. Springer
- Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India.

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V-Semester
PHYSICS

SEC2-PHY502D: PROJECT AND DISSERTATION

(Credits: 02) Theory: 30 Lectures

V-Semester
PHYSICS
DSE1-PHY503T1: QUANTUM MECHANICS
(Credits: Theory-04) 60 Lectures

UNIT-1

Time dependent Schrodinger equation: Time dependent Schrodinger equation and dynamical evolution of a quantum state; Properties of wave functions. Interpretation of wave function. Probability and probability current densities in three dimensions; Conditions for Physical Acceptability of Wave Functions. Normalization. Linearity and Superposition Principles. Eigen values and Eigen functions, Expectation values of position and momentum. Wave Function of a Free Particle. (6 lectures)

UNIT-2

Time independent Schrodinger equation-Hamiltonian, stationary states and energy eigen values; expansion of an arbitrary wave function as a linear combination of energy eigen functions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; wave packets, Fourier transforms and momentum space wave function: Position-momentum uncertainty principle. (10 lectures)

UNIT-3

General discussion of bound states in an arbitrary potential- continuity of wave function, boundary condition and emergence of discrete energy levels; application to one-dimensional problem- square well potential; Quantum mechanics of simple harmonic oscillator-energy levels and energy eigenfunctions using Frobenius method. (12 Lectures)

UNIT-4

Quantum theory of hydrogen-like atoms: time independent Schrodinger equation in spherical polar coordinates; separation of variables for the second order partial differential equation; angular momentum operator and quantum numbers; Radial wavefunctions from Frobenius method; Orbital angular momentum quantum numbers l and m; s, p, d,.. shells (idea only). (10 Lectures)

UNIT-5

Atoms in Electric and Magnetic Fields:- Electron Angular Momentum. Space Quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman Effect: Electron Magnetic Moment and Magnetic Energy. Gyromagnetic Ratio and Bohr Magneton. (8 Lectures)

Atoms in External Magnetic Fields:- Normal and Anomalous Zeeman Effect. (4 Lectures)

UNIT-6

Many electron atoms:- Pauli's Exclusion Principle. Symmetric and Antisymmetric Wave Functions. Periodic table. Fine structure. Spin orbit coupling. Spectral Notations for Atomic States. Total Angular Momentum. Vector Model. Spin-orbit coupling in atoms-L-S and J-J couplings. (10 Lectures)

Reference Books:

- A Text book of Quantum Mechanics, P.M. Mathews & K. Venkatesan, 2nd Ed., 2010, McGraw Hill.
- Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002, Wiley.
- Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGraw Hill.
- Quantum Mechanics, G. Aruldhas, 2nd Edn. 2002, PHI Learning of India.
- Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.
- Quantum Mechanics for Scientists & Engineers, D.A.B. Miller, 2008, Cambridge University Press.

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Additional Books for Reference

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

DSE1-PHY503P1: QUANTUM MECHANICS PRACTICALS-V
(Practical Credits =2) 60 Lectures

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

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

$$\frac{d^2y}{dr^2} = A(r)u(r), \qquad A(r) = \frac{2m}{\hbar^2}[V(r) - E] \qquad where\ V(r) = -\frac{e^2}{r}$$

Here, m is the reduced mass of the electron. Obtain the energy eigenvalues and plot the corresponding wavefunctions. Remember that the ground state energy of the hydrogen atom is ≈ -13.6 eV. Take e = 3.795 $(eVÅ)^{1/2}$, ħc = 1973 (eVÅ) and m = 0.511×10^6 eV/c^2.

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

$$\frac{d^2y}{dr^2} = A(r)u(r), \qquad A(r) = \frac{2m}{\hbar^2}[V(r) - E]$$

Where m is the reduced mass of the system (which can be chosen to be the mass of an electron), for the screened coulomb potential

$$V(r) = -\frac{e^2}{r}e^{-r/a}$$

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

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

$$\frac{d^2y}{dr^2} = A(r)u(r), \qquad A(r) = \frac{2m}{\hbar^2}[V(r) - E]$$

For the anharmonic oscillator potential

$$V(r) = \frac{1}{2}kr^2 + \frac{1}{3}br^3$$

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

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

$$\frac{d^2y}{dr^2} = A(r)u(r), \qquad A(r) = \frac{2\mu}{\hbar^2}[V(r) - E]$$

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

$$V(r) = D\left(e^{-2ar'} - e^{-ar'}\right), \qquad r' = \frac{r - r_o}{r}$$

Find the lowest vibrational energy (in MeV) of the molecule to an accuracy of three significant digits. Also plot the corresponding wave function. Take: m = 940x10^6eV/C^2, D = 0.755501 eV, α = 1.44, r_o = 0.131349 Å

Laboratory based experiments:

5. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency
6. Study of Zeeman effect: with external magnetic field; Hyperfine splitting
7. To study the quantum tunnelling effect with solid state device, e.g. tunnelling current in backward diode or tunnel diode.

Reference Books:

- Schaum's Outline of Programming with C++. J.Hubbard, 2000, McGraw-Hill Publications.
- Numerical Recipes in C: The Art of Scientific Computing, W.H.Press et al., 3rdEdn., 2007, Cambridge University Press.
- Elementary Numerical Analysis, K.E.Atkinson, 3 rd Edn. , 2007, Wiley India Edition.
- A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3rd Edn., Cambridge University Press
- Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández.2014 Springer ISBN: 978-3319067896
- Scilab by example: M. Affouf2012ISBN: 978-1479203444
- Scilab (A Free Software to Matlab): H. Ramchandran, A.S. Nair. 2011 S. Chand and Company. New Delhi ISBN: 978-8121939706
- Scilab Image Processing: Lambert M. Surhone. 2010Betascript Publishing ISBN: 978-6133459274A
- Quantum Mechanics, Leonard I. Schiff, 3rdEdn. 2010, Tata McGraw Hill.
- Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.

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V-Semester
PHYSICS
DSE1-PHY503T2: SOLID STAE PHYSICS
(Credits: Theory-04) 60 Lectures

UNIT-1

Crystal Structure: Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis. Unit Cell. Miller Indices. Types of Lattices. Bravias Lattice. Brillouin Zones. Diffraction of X-rays by Crystals. Bragg's Law and Bragg spectrometer. Determination of crystal structure of NaCl. (12 Lectures)

UNIT-2

Elementary Lattice Dynamics: Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids. T^3 law (10 Lectures)

UNIT-3

Magnetic Properties of Matter: Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of dia – and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Weiss's Theory of Ferromagnetism Discussion of B-H Curve. Hysteresis and Energy Loss. (12 Lectures)

UNIT-4

Dielectric Properties of Materials: Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability. Langevin-Debye equation. Complex Dielectric Constant. Optical Phenomena: Plasma Oscillations, Plasma Frequency, Plasmons. (10 Lectures)

UNIT-5

Elementary band theory: Kronig Penny model. Band Gaps. Conductors, Semiconductors and insulators. P and N type Semiconductors. Conductivity of Semiconductors, mobility, Hall Effect. Hall coefficient. (8 Lectures)

UNIT-6

Superconductivity: Super conductivity, **BCS theory of superconductivity.** Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, London's Equation. **High TC Superconductors.** (8 Lectures)

Reference Books:

- Introduction to Solid State Physics, Charles Kittel, 8th Ed., 2004. Wiley India Pvt. Ltd.
- Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India
- Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
- Solid State Physics, Neil W. Ashcroft and N. David Mermin, 1976, Cengage Learning
- Solid State Physics, Rita John, 2014, McGraw Hill
- Solid-state Physics, H. Ibach and H Luth, 2009, Springer
- Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India
- Solid State Physics, M.A. Wahab, 2011, Narosa Publications

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DSE1-PHY503P2: SOLID STAE PHYSICS PRACTICALS-V
(Practical Credits =2) 60 Lectures

1. Measurement of susceptibility of paramagnetic solution
2. To measure the Magnetic susceptibility of Solids.
3. To determine the inter planar spacing d and structure factor S using X-ray powder diffraction film.
4. To measure the Dielectric Constant of a dielectric Materials with frequency
5. To determine the complex dielectric constant of solids
6. To determine the refractive index of a dielectric materials
7. To the Temperature coefficient of resistance of semiconductor.
8. To draw the BH curve of iron and determine the energy loss from Hysteresis.
9. To measure the resistivity of a semiconductor (Ge) crystal with temperature by four-probe method (from room temperature to 150 °C) and to determine its band gap.
10. To Determine the Energy gap of a semiconductor.
11. Assignment-I
12. Assignment-II
13. Assignment-III
14. Assignment-IV
15. Assignment-V

(Some other new experiments may be added by the approval of BOS)

Reference Books

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

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VI- Semester
PHYSICS
SKILL ENHANCEMENT COURSE

SEC3-PHY601T: RADIATION SAFETY
(Credits: =2) 30 Lectures

The aim of this course is for awareness and understanding regarding radiation hazards and safety. The list of laboratory skills and experiments listed below the course are to be done in continuation of the topics

UNIT-1

Types of Radiation

Electromagnetic radiations: X-rays characteristics and production, Concept of Bremsstrahlung, auger effect, Gamma decay and source. Particle radiations: Basic concept of Alpha, Beta and Neutron decay and their sources. Sealed and unsealed sources. (5 Lectures)

UNIT-2

Interaction of Radiation with Matter

Interaction of Photons: Photo-electric effect, Compton effect and Pair production. Linear and mass attenuation coefficients. Interaction of charged particles: Heavy charged particles, Bethe-Bloch formula, Scaling laws, Mass stopping power, Range, Straggling. (7 Lectures)

UNIT-3

Radiation Quantities and Detection

Radiation quantities and units: Dosimetric Quantities: Basic idea of different units of activity, Exposure (rate), KERMA (rate), Absorbed dose rate. Radiation protection quantities: Equivalent dose (rate), Effective dose (rate), Annual Limit of Intake (ALI). Radiation Detection: Basic concept and working principle of gas detectors (Ionization Chambers, Proportional Counter, Gieger-Muller Counter). Scintillation Detectors (Inorganic and organic Scintillators), Solid State Detectors, Neutron Detectors and Thermo-luminescent Dosimetry. (10 Lectures)

UNIT-4

Radiation effect on human life

Biological effects of ionizing radiation on cells. Radiation effect on developing embryo and fetus. Whole-body exposure effect. Dose and risks associated with diagnostic radiology (X-ray, CT, Mammography, Fluoroscopy), interventional radiology and nuclear medicines Nuclear waste and disposal management. Hazards of MRI and Ultrasonography. (8 Lectures)

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SEC3-PHY601P: RADIATION SAFETY- LAB

Experiments:

1. Study of background radiations levels using radiation meter.
2. Study of counting statistics and error prediction
3. Study the Characteristics of GM counter and determine the operating voltage
4. Study of radiation in KSO_4 and other materials
5. Study of absorption of beta particles in Aluminum using GM Counter
6. Study of absorption of gamma rays in Aluminum using GM Counter
7. Determination of half life of a source using GM tube
8. Verification of inverse square law using GM counter

Activity: Visit to the nearest Nuclear Power Plants, Nuclear Research Centers and Diagnostics Centers to study and understand the measures taken for radiation safety.

Reference Books:

- Radiation detection and measurements – G F Knoll
- Fundamental physics of radiology – John Wright and sons
- Nuclear radiation detectors – S S Kapoor and V S Ramamurthy
- Radiation protection and dosimetry – Michael G. Stabin
- Medical radiation physics – W R Hendee
- NCRP, ICRP, ICRU, IAEA and AERB publications

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V-Semester
PHYSICS
SKILL ENHANCEMENT COURSE

SEC4 PHY602T: RENEWABLE ENERGY AND ENERGY HARVESTING
(Credits: = 2) 30 Lectures

UNIT-1

Fossil fuels and Alternate Sources of energy:
Fossil fuels and Nuclear Energy, their limitations, Need of renewable energy, non-conventional energy sources, developments in offshore Wind energy, Tidal Energy, Wave energy systems. Ocean thermal energy Conversion, Solar energy, Bio-mass, Biochemical conversion, Bio-gas generation. Geothermal energy, tidal energy, Hydroelectricity. (3 Lecturers)

Wind Energy Harvesting:
Wind energy Fundamentals of wind energy, Wind Turbines, types of wind machines, performance of wind machine. Application of wind energy and environmental aspects. (3 Lectures)

UNIT-2

Solar energy:
Solar energy, its importance, storage of solar energy, solar electric power generation, solar pond applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green house, solar cell, solar photo voltaic and sun tracking systems.
(5 Lecturers)

UNIT-3

Ocean Energy:
Ocean Energy, ocean thermal electrical conversion, methods of ocean thermal electrical power generation. Advantages and disadvantages of wave energy, wave energy device. (3 Lecturers)

Tidal Energy:
Tidal energy, basic principal of tidal power estimation of energy, power in a double cycle system. Osmotic power, ocean bio-mass. (2 Lecturers)

Geothermal Energy: Geothermal Resources, Geothermal Technologies. (2 Lecturers)

Hydro Energy: Hydropower resources, hydropower Technologies, environmental impact of hydro power sources. (2 Lecturers)

UNIT-4

Piezoelectric Energy Harvesting:
Introduction, Physics and characteristics of piezoelectric effect, materials Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energy harvesting applications, Human power.
(4 Lecturers)

Electromagnetic Energy Harvesting: Linear generators, Recent applications Carbon captured technologies, cell, batteries, power consumption. (4 Lecturers)

Environmental issues and Renewable sources of energy, sustainability. (2 Lecturers)

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SEC4 PHY602P: RENEWABLE ENERGY AND ENERGY HARVESTING- LAB

Demonstrations and Experiments:

1. Demonstration of training models on solar energy, Wind energy, etc.
2. Conversion of vibration to voltage using piezoelectric materials.
3. Conversion of thermal energy into voltage using thermoelectric models.
4. Determination of wind energy using data.
5. Study of gobar gas plant.

(Some other new skill based experiments to be added by approval of BOS)

Reference Books:

- Nonconventional energy sources – G. D. Rai –Khanna publication, New Delhi
- Solar energy – M.P. Agarwal – S Chand and Co. Ltd.
- Solar energy _- Suhas P Sukhative Tata McGraw-Hill Publishing Company Ltd.
- Godfrey Boyle , Renewable energy, Power for a sustainable future, 2004, Oxford University Press in association with The Open University.
- Dr. P Jayakumar, Solar energy: Resource Assesment Handbook, 2009
- J.Balfour, M. Shaw and S. Jarosek, Photovoltaics J Lawrence J Goodrich (USA)
- http://en.wikipedia.org/wiki/Renewable_energy.

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VI-Semester
PHYSICS
DSE4-PHY603T1: NUCLEAR AND PARTICLE PHYSICS

(Credits: Theory-04) 60 Lectures

UNIT-1

General Properties of Nuclei: Constituents of nucleus and their Intrinsic properties, quantitative facts about size, mass, charge density (matter energy), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, angular momentum, parity, magnetic moment, electric moments, nuclear excites states.

(8 Lectures)

UNIT-2

Nuclear Models: Liquid drop model approach, semi empirical mass formula and significance of various terms, condition of nuclear stability. Nuclear Shell model: basic assumption of Shell model & evidence for nuclear shell structure, nuclear magic numbers. Concept of nuclear force and its properties. (9 Lectures)

UNIT-3

Radioactivity decay: (a) Alpha decay: basics of α-decay processes, theory of α- -decay, Gamow factor, Geiger Nuttall law. (b) β-decay: energy kinematics for β-decay, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays emission & kinematics, internal conversion. (10 Lectures)

UNIT-4

Nuclear Reactions: Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct reaction, resonance reaction.

(8 Lectures)

UNIT-5

Detector for Nuclear Radiations: Gas detectors: estimation of electric field, mobility of particle, for ionization chamber and GM Counter. Basic principle of Scintillation. Detectors and construction of photo-multiplier tube (PMT). Semiconductor Detectors (Si & Ge) for charge particle. (9 Lectures)

Particle Accelerators: Types of accelerators, accelerators facility available in India: Van-de Graff generator (Tandem accelerator), Linear accelerator, Cyclotron, and Betatron. (6 Lectures)

UNIT-6

Particle physics: Particle interactions; basic features, types of particles and its families. Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness and charm, concept of quark model, color quantum number and gluons. (10 Lectures)

Reference Books:

- Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
- Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998).
- Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004).
- Introduction to Elementary Particles, D. Griffith, John Wiley & Sons
- Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, New Delhi

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- Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde IOP-Institute of Physics Publishing, 2004).
- Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
- Theoretical Nuclear Physics, J.M. Blatt & V.F.Weisskopf (Dover Pub.Inc., 1991)
- Nuclear Physics, DC Tayal.
- Modern Physics, BY Murgheshan.

DSE4-PHY603P1: NUCLEAR AND PARTICLE PHYSICS-PRACTICALS-VI
(Credits: Practicals-02) 60 Lectures

1. Classification of GM Counter
2. Verification Of Inverse Square Law Using GM Counter
3. Absorption Coefficient Of Aluminium Beta Ray
4. Determination Of Half Life Of K-40 Using GM Counter
5. Determination Of Dead Time Using GM Counter
6. Study Of Statistical Distribution On Nuclear Disintegration Data (Using GM Counter As A Black Box)
7. Characteristics Of Photo Cell, Determination Of Stopping Potential
8. Determination of Plancks Constant.
9. Assignment-I
10. Assignment-II
11. Assignment-III
12. Assignment-IV
13. Assignment-V

(Some other new experiments to be added by approval of BOS)

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VI-Semester
PHYSICS
DSE4-PHY603T2: MEDICAL PHYSICS
(Credits: Theory-04) 60 Lectures

UNIT-1

Physics of the Body-I

Basic Anatomical Terminology: Standard Anatomical Position, Planes. Familiarity with terms like - Superior, Inferior, Anterior, Posterior, Medial, Lateral, Proximal and Distal.

Mechanics of the body: Skeleton, forces, and body stability. Muscles and Dynamics of body Movement.

Physics of Locomotors Systems: Joints and Movements, Stability and Equilibrium.

Energy Household of the body: Energy balance in the body, Energy consumption of the body, Heat losses of the body, Thermal Regulation.

Pressure System of body: Physics of breathing, Physics of cardiovascular system. (8 Lectures)

UNIT-2

Physics of the Body-II

Acoustics of the body: Nature and characteristics of sound, Production of speech, Physics of the ear, Diagnostics with sound and ultrasound.

Optical system of the body: Physics of the eye.

Electrical system of the body: Physics of the nervous system, Electrical signals and information transfer. (10 Lectures)

UNIT-3

Physics of Diagnostic and Therapeutic Systems-I

X-RAYS: Electromagnetic spectrum, production of x-rays, x-ray spectra, Brehmsstrahlung, Characteristic of x-ray. **X-ray Tubes & Types:** Coolidge tube, x-ray tube design, tube cooling stationary mode, Rotating anode x-ray tube, Tube rating, quality and intensity of x-ray. X-ray generator circuits, half wave and full wave rectification, filament circuit, kilo voltage circuit, types of X-Ray Generator, high frequency generator, exposure timers and switches, HT cables, HT generation. (7 Lectures)

Radiation Physics: Radiation units exposure, absorbed dose, units: rad, gray,relative biological effectiveness, effective dose, inverse square law. Interaction of Radiation with matter. Compton & Photoelectric Effect, Rem & Sievert Linear Attenuation Coefficient.

Radiation Detectors: Thimble chamber, condenser chambers, Geiger Muller Counter, Scintillation Counters and Solid State detectors, ionization chamber, Dosimeters, survey methods, area monitors, TLD, Semiconductor detectors. (7 Lectures)

UNIT-4

Medical Imaging Physics: Evolution of Medical Imaging, X-ray diagnostics and imaging, Physics of nuclear magnetic resonance (NMR), NMR imaging, MRI Radiological imaging, Ultrasound imaging, Physics of Doppler with applications and modes, Vascular Doppler. **Radiography:** Filters, grids, cassette, X-ray film, film processing, fluoroscopy.

Computed Tomography Scanner- Principle & Function, Display, Generations, mammography, Thyroid uptake system and Gamma camera (Only Principle, function and display). (9 Lectures)

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UNIT-5

Radiation Oncology Physics: External Beam Therapy (Basic Idea): Tele-cobalt, Conformal Radiation Therapy (CRT), 3DCRT, IMRT, Image Guided Radiotherapy, EPID, Rapid Arc, Proton Therapy, Gamma Knife, Cyber Knife. Contact Beam Therapy (Basic Idea): Brach therapy-LDR and HDR, Intra Operative Brach therapy. Radiotherapy, kilo voltage machines, deep therapy machines, Tele-cobalt machines. Medical Linear Accelerator. Basics of Tele-therapy units, deep x-ray, Tele-cobalt units, medical linear accelerator, Radiation protection, external beam characteristics, dose maximum and build up – bolus, percentage depth dose, tissue maximum ratio and tissue phantom ratio, Planned target Volume and Gross Tumor Volume.

(9 Lectures)

UNIT-6

Radiation and Radiation Protection: Principles of radiation protection, protective materials-radiation effects, somatic, genetic stochastic and deterministic effect. Personal monitoring devices: TLD film badge, pocket dosimeter, OSL dosimeter. Radiation Dosimeter. Natural radioactivity, Biological effects of radiation, Radiation monitors. Steps to reduce radiation to Patient, Staff and Public. Dose Limits for Occupational workers and Public. AERB: Existence and Purpose. (5 Lectures)

Physics of Diagnostic and Therapeutic Systems-II

Diagnostic nuclear medicine: Radiopharmaceuticals for radioisotope imaging, Radioisotope imaging equipment, Single photon and positron emission tomography.

Therapeutic nuclear medicine: Interaction between radiation and matter Dose and Isodose in radiation treatment. Medical Instrumentation: Basic Ideas of Endoscope and Cautery, Sleep Apnea and Capp Machines, Ventilator and its modes. (5 Lectures)

References:

- Medical Physics, J.R. Cameron and J.G. Skofronick, Wiley (1978)
- Basic Radiological Physics Dr. K. Thayalan - Jayapee Brothers Medical Publishing Pvt. Ltd. New Delhi (2003)
- Christensen's Physics of Diagnostic Radiology: Curry, Dowdey and Murry-Lippincot Williams and Wilkins (1990)
- Physics of Radiation Therapy: F M Khan - Williams and Wilkins, Third edition(2003)
- Physics of the human body, Irving P. Herman, Springer (2007).
- The essential physics of Medical Imaging: Bushberg, Seibert, Leidholdt and
- Boone Lippincot Williams and Wilkins, Second Edition (2002)
- Handbook of Physics in Diagnostic Imaging: R.S. Livingstone: B.I. PublicationPvt Ltd.
- The Physics of Radiology-H E Johns and Cunningham.

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DSE4-PHY603P2: MEDICAL PHYSICS PRACTICALS-VI
(Credits: Practicals-02) 60 Lectures

1. Understanding the working of a manual Hg Blood Pressure monitor and measure the Blood Pressure.
2. Understanding the working of a manual optical eye-testing machine and to learn eye-testing.
3. Correction of Myopia (short sightedness) using a combination of lenses on an optical bench/breadboard.
4. Correction of Hypermetropia /Hyperopia (long sightedness) using a combination of lenses on an optical bench/breadboard.
5. To learn working of Thermoluminescent dosimeter (TLD) badges and measure the background radiation.
6. Familiarization with Geiger-Muller (GM) Counter and to measure background radiation.
7. Familiarization with Radiation meter and to measure background radiation.
8. Familiarization with the Use of a Vascular Doppler.

Reference Books:

- Basic Radiological Physics Dr. K. Thayalan - Jayapee Brothers Medical Publishing Pvt. Ltd. New Delhi (2003)
- Christensen's Physics of Diagnostic Radiology: Curry, Dowdey and Murry - Lippincot Williams and Wilkins (1990)
- Physics of Radiation Therapy: F M Khan - Williams and Wilkins, Third edition (2003)
- The essential physics of Medical Imaging: Bushberg, Seibert, Leidholdt and 35
- Boone Lippincot Williams and Wilkins, Second Edition (2002)
- The Physics of Radiology-H E Johns and Cunningham.
- Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, AsiaPublishing House.
- Handbook of Physics in Diagnostic Imaging: Roshan S. Livingstone: B. I. Publications Pvt Ltd.
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

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