SACRED HEART COLLEGE (AUTONOMOUS)

Department of Physics

BSc Physics

COURSE PLAN 2015 - 16

(Semester V)

PROGRAMME	BSc Physics	SEMESTER	5
COURSE TITLE	CLASSICAL & QUANTUM MECHANICS	CREDIT	4
Theory HOURS/WEEK	3	HOURS/SEM	54
FACULTY NAME	Prof. Alex Shinu Scaria		

COURSE OBJECTIVES
Explain the basic formalisms in classical mechanics
Illustrate the failure of Classical physics and to explain the new emergence of matter wave concept
Illustrate the basic formulations of Quantum Mechanics

SESSION	**TOPIC**	**LEARNING RESOURCES**	**REMARKS**
	MODULE I		
1	Introduction – to Classical Mechanics	Lect+discussion	
2	Constraints and degrees of freedom	Lect+discussion	
3	Generalized coordinates – Classification of a dynamical system	Lect+discussion	
4	Principle of virtual work	Lect+discussion	
5	D'Alemberts Principle	Lect+discussion	
6	Lagrange's equations (NO DERIVATION)	Lect+discussion	
7	Linear Harmonic Oscillator	Lect+discussion	
8	Planetary motion	Lect+discussion	
9	Simple Pendulum	Lect+discussion	
10 -11	Hamilton's Canonical equations of motion, Advantages of Hamilton's method	Lect+discussion	
12	Applications of Hamilton's method - Linear Harmonic oscillator	Lect	

13	Applications of Hamilton's method Simple pendulum only .	Lect+discussion	
14	Hamilton's Principle of Least Action	Lect+discussion	
15 -16	Derivation of Lagrange's equation from Hamilton's Principle.	Lect+discussion	
17	Calculus of Variation	Lect+discussion	
18	Problem Discussion	discussion	
	MODULE II		
19	Emergence of quantum concepts - Introductory Interacion	Interaction	
20	Black body radiation	Lect+discussion	
21	Planck's law - Particle nature of radiation –	Lect+discussion	
22	Photoelectric effect	Assignment	
23 -24	Compton effect - wave nature of matter	Derivation	
25	deBroglie hypothesis – Davisson and Germer experiment	Lect+discussion	
26	Uncertainty principle	Lect+discussion	
27	Probabilistic interpretation of wave function.	Lect+discussion	
28 -29	The Schrodinger equation	Lect+discussion	
30	Operators - The commutator	Activity	
31	Physical Interpretation of wave function – Normalisation probability current density	Lect+discussion	
32	Expectation value , Problem Solving	Lect + Activity	
33	General eigen value equation – eigen value for momentum operator.	Activity	
34	Problem Discussion	Problem Solving	
	MODULE III		
35 -36	Stationary state - Time independent Schrodinger equation	Lecture& Derivation	
37	Boundary and continuity condition for wave functions – degeneracy	Lecture	

38 -39	Orthogonality of wave function	Lecture& Derivation	
40 -41	Particle in a box (one dimensional)	Lecture& Derivation	
42,43,44	Energy eigen value and zero point energy (Simple Harmonic oscillator)	Lecture& Derivation	
45,46,47	Orbital angular momentum– commutation relations	Lecture& Derivation	
48,49,50	Eigen values of L^2 , L_z	Lecture& Derivation	
51,52,53	Energy eigen values of rigid rotator	Lecture& Derivation	
54	Problem Solving	Activity	

INDIVIDUAL ASSIGNMENTS/SEMINAR – Details & Guidelines

	Date of completion	Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)
1	Before 1st Internal	Problems (Best of 3)
2	Before 2nd Internal	Problems (Best of 2)

Text Books:

1. Text book: Classical Mechanics by J.C. Upadhyaya-Chapter 2 & 3.
2. Classical Mechanics by G. Aruldhas 2. Modern Physics, Kenneth S Krane (2nd Edition) -Wiley.
3. Concepts of modern Physics, Arthur Beiser (6th Edition)
4. A Textbook of Quantum Mechanics- G Aruldhas- (2nd Edition)- PHI

References:

1. Classical Mechanics - 3 rd Edition: Herbert Goldstein, Charles Poole & John Safk, Pub. Pearson Education (Indian Edn.)
2. Mechanics, Hans & Puri, TMH
3. Classical Mechanics – Rana & Joag, TMH
4. Classical Mechanics – Greiner, Springer International Edn.
5. Classical Mechanics- Vimal Kumar Jain Ane Books Pvt. Ltd.
6. Quantum Physics – Stephen Gasirowicz Pub. Pearson Education (IndianEdn.)
7. Quantum Mechanics - Greiner, 4 th Edition, Springer International Edn.
8. Quantum Mechanics G. Aruldhas, Premtice Hall of India.
9. Concepts of Modern Physics - Arthur Beiser, Tata Mc Graw Hill. 10. Applied Quantum Mechanics, A F J Levi, Cambridge Univ.

PROGRAMME	BSc PHYSICS	SEMESTER	5
COURSE TITLE	PHYSICAL OPTICS AND PHOTONICS	CREDIT	3
Theory HOURS/WEEK	3	HOURS/SEM	54
FACULTY NAME	Dr. Jimmy Sebastia		

COURSE OBJECTIVES
Explain the basic principles of Optics, lasers, holography and fiber technology.
Apply the principles of Optics to Optical systems.
Solve specific problems in optics and lasers.
Analyze Optical systems and phenomenon based on the theory of Optics.

Sessions	**Topic**	**Learning Resources**	**Remarks**
1	Light	Lecture + Interaction	
2	Review of basic ideas of interference	Lecture + Interaction	
3	Coherent waves-Optical path and phase change-superposition of waves, condition for bright and dark fringes	Lecture + Interaction	
4	Problem solving session	Lecture + Interaction	
5	Thin film, interference an introduction	Lecture + Interaction	
6	Thin film, interference due in reflected light	Lecture + Interaction	
7	Thin film, interference in transmitted light	Lecture + Interaction	
8	Haidinger fringes and problem-solving session	Lecture + Interaction	
9	Interference in wedge shaped film, colours in thin films	Lecture + Interaction	
10	Newtons rings	Lecture + Interaction	
11	Michelson interferometer, construction and working	Lecture + Interaction	

12	Fresnel Diffraction - Huygens- Fresnel theory	Lecture + Interaction	
13	Zone plate	Lecture + Interaction	
14	Difference between zone plate and convex lens	Lecture + Interaction	
15	Interference and diffraction comparison	Lecture + Interaction	
16	Problem solving session	Lecture + Interaction	
17	Diffraction pattern due to a straight edge	Lecture + Interaction	
18	single silt diffraction	Lecture + Interaction	
19	Revision of diffraction	Lecture + Interaction	
20	Fraunhoffer diffraction at a single slit	Lecture + Interaction	
21	Fraunhoffer diffraction at a double slit	Lecture + Interaction	
22	Fraunhoffer diffraction in N slits, theory of plane diffraction grating	Lecture + Interaction	+
23	Problem solving of diffraction	Lecture + Interaction	
24	Concept of polarization – (plane of polarization)	Lecture + Interaction	
25	polarization by reflection-Brewster's law	Lecture + Interaction	
26	polarization by refraction-pile of plates	Lecture + Interaction	
27	Polarization by double refraction-(calcite crystal). Anisotropic crystals – optic axis	Lecture + Interaction	
28	Double refraction-Huygens explanation of double refraction-Positive and Negative crystals	Lecture + Interaction	
29	Types of polarized light-Retarders or wave plate - Quarter wave plate - Half wave plate	Lecture + Interaction	

30	Production and Detection of elliptically and circularly polarized light	Lecture + Interaction	
31	Optical Activity-Fresnels Explanation of Optical Rotation	Lecture + Interaction	
32	Specific Rotation-Laurents half shade polarimeter	Lecture + Interaction	
33	Problems	Lecture + Interaction	,
34	Absorption and emission of light-Absorption	Lecture + Interaction	
35	spontaneous emission and stimulated emission-light amplification by stimulated emission	Lecture + Interaction	
36	Einstein's relations, condition for light amplification – population inversion	Lecture + Interaction	
37	pumping –pumping methods –optical pumping – electrical pumping -direct conversion	Lecture + Interaction	
38	Active medium-metastable states	Lecture + Interaction	
39	pumping schemes (two level, three level and four level) Optical resonator	Lecture + Interaction	
40	Threshold condition. Types of lasers-ruby laser	Lecture + Interaction	
41	He-Ne laser, Semi-conductor laser	Lecture + Interaction	
42	Applications of lasers-Holography (principle, recording and reconstruction)	Lecture + Interaction	
43	Problems	Lecture + Interaction	
44	Optical fibre introduction	Lecture + Interaction	
45	Optical fibre Critical angle of propagation	Lecture + Interaction	
46	Problems	Interaction	
47	modes of propagation - Acceptance angle	Lecture + Interaction	

48	Fractional refractive index change - Numerical Aperture	Lecture + Interaction	
49	Types of Optical fibers -1	Lecture + Interaction	
50	Types of Optical fibers -2	Lecture + Interaction	
51	Normalized Frequency - pulse dispersion Attenuation	Lecture + Interaction	
52	Applications	Lecture + Interaction	
53	Fiber optic Communication system - Advantages of Optical fibers.	Lecture + Interaction	
54	Problems	Interaction	

INDIVIDUAL ASSIGNMENTS/SEMINAR – Details & Guidelines

	Date of completion	Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)
1	Before 1st Internal	Individual- Graded – Best of 2 sets
2	Before 2nd Internal	Individual- Graded –Best of 2 sets

ASSIGNMENTS– Details & Guidelines – Will be notified prior to the announcement of the assignment – marks will be scaled to 5.

SEMINARS will be given to each student (20 mins duration) – 5 marks (,)

REFERENCE

1. Optics 3 rd edition- Ajoy Ghatak, TMH

2. Optical Electronics – Ajoy Ghatak and K Thyagarajan, Cambridge

3. Optics and Atomic Physics D P Khandelwal, Himalaya Pub. House

4. Optics S K Srivastava, CBS Pub. N Delhi

5. A Text book of Optics S L Kakani, K L Bhandari, S Chand**.**

6. An introduction to lasers theory and applications.MN Avadhanulu.S.Chand

7. Optics by Subramanayam, Brijlal, MN Avadhanalu, S.Chand

COURSE PLAN

PROGRAMME	BSc PHYSICS	SEMESTER	5
COURSE CODE AND TITLE	Thermal and Statistical Physics	CREDIT	3
Theory HOURS/WEEK	3	HOURS/SEM	54
FACULTY NAME	Dr. Roby Cherian		

COURSE OBJECTIVES
Understand the basic concepts in thermodynamics and the formulations to appreciated various applications which made our life easy and comfortable.
Acquire the skill in describing mathematical formulations in thermodynamics extend it various thermo dynamical phenomena happening in our day to day life.
Understand and appreciate the significance of statistical approach to explain the complicated behavior of atoms and molecules in the micro world.

SESSION	**TOPIC**	**LEARNING RESOURCES**	**REMARKS**
MODULE I Thermal Physics 18 hrs (Dr. Pius Augustine)			
1.	Introduction to Thermodynamics	Lecture/PPT	
2.	Laws of Thermodynamics: Zeroth law.	Lecture/PPT	
3.	First law- internal energy	Lecture/PPT	
4.	Applications of first law	Lecture/PPT	
5.	Indicator diagram	Lecture/PPT	
6.	Work done during isothermal and adiabatic process, slopes, relation between them	Lecture/PPT	
7.	Work done during isothermal and adiabatic process, slopes, relation between them	Lecture/PPT	
8.	cooling due to Adiabatic reversible processes	Lecture/PPT	
9.	Reversible and irreversible processes and Problem solving	Lecture/PPT	
10.	Second law	Lecture/PPT	
11.	Heat Engines	Lecture/PPT	
12.	Carnot cycle and theorem	Lecture/PPT	
13.	Work done by the engine per cycle	Lecture/PPT	
14.	efficiency, Otto Engine	Lecture/PPT	
15.	Petrol engine	Lecture/PPT	
16.	Diesel Engine	Lecture/PPT	
17.	Third law of thermodynamics -Unattainability of absolute zero	Lecture/PPT	
18.	Revision and Problem solving	Lecture/PPT	

Module II (18 hrs) Thermodynamic relations and Heat Transmission Dr. Pius Augustine			
19.	Entropy	Lecture/PPT	
20.	Entropy changes in reversible and irreversible processes	Lecture/PPT	
21	Entropy – temperature diagrams and equations	Lecture/PPT	
22	Physical significance of entropy	Lecture/PPT	
23	Clausius Clepeyron Equation	Lecture/PPT	
24	Thermodynamic potentials	Lecture/PPT	
25.	Enthalpy	Lecture/PPT	
26.	Gibbs and Helmholtz functions	Lecture/PPT	
27.	Revision and Problem solving	Lecture/PPT	
28.	Maxwell's relations and applications	Lecture/PPT	
29.	Concepts of adiabatic and isothermal elasticity	Lecture/PPT	
30.	Revision and Problem solving	Lecture/PPT	
31.	Modes of heat transfer	Lecture/PPT	
32.	Searle's & Lee's experiment	Lecture/PPT	
33.	black body radiation	Lecture/PPT	
34.	StefanBoltzmann Law	Lecture/PPT	
35.	Wein's displacement law, Rayleigh -Jean's Law, Planck's law (no derivation).	Lecture/PPT	
36.	Revision and Problem Solving	Lecture/PPT	
Module III (18 hrs) Statistical Mechanics (18hrs) Dr. Roby Cherian			
37.	Micro and Macro states	Lecture/PPT	
38.	thermodynamic probability	Lecture/PPT	
	energy states, energy levels	Lecture/PPT	
39	degenerate energy levels	Lecture/PPT	
40	degenerate gas	Lecture/PPT	
41	First Internal Exam		
42	phase space	Lecture/PPT	
43	concept of entropy and thermodynamic probability	Lecture/PPT	
44	Classical Statistics: Maxwell-Boltzmann Distribution law	Lecture/PPT	
45	thermodynamics of an ideal monoatomic gas	Lecture/PPT	
46	Second Internal Exam	Lecture/PPT	
47	Classical entropy expression, Gibbs' paradox	Lecture/PPT	

48	Quantum Statistics: Need of quantum statistics- In-distinguishability of particles	Lecture/PPT	
49	Spin and StatisticsIdeas of Bose Einstein distribution law	Lecture/PPT	
50	Spin and StatisticsIdeas of Bose Einstein distribution law and its application to black body radiation	Lecture/PPT	
51	Fermi Dirac Statistics and its application to electron gas	Lecture/PPT	
52	Fermi Dirac Statistics and its application to electron gas	Lecture/PPT	
53	Revision	Lecture/PPT	
54	Exams.		

INDIVIDUAL ASSIGNMENTS/SEMINAR – Details & Guidelines

	Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)	
1	Make a comprehensive analysis of various thermodynamical processes taking place in our kitchen – Kitchen Physics	Presentation in groups and submission of report and ppt. Video recording
2	Seminar/assignment on conduction, convection and radiation on a broader scale. Video record your presentation and make available in Youtube.	Presentation in groups and submission of report and ppt.

INDIVIDUAL ASSIGNMENTS/SEMINAR – Details & Guidelines

Books for references

1. Heat and Thermodynamics, Mark W Zemaskay and Richard H Dittman, Tata McGraw-Hill Publishing Co. (Special Indian Edition)
2. Thermodynamics and Statistical Mechanics, Greiner, Springer
3. Berkeley Physics Course Volume 5; Statistical Physics; Frederick Reif. McGraw Hill.
4. A Treatise on Heat; Saha and Srivastava, The Indian Press, Allahabad.
5. Statistical Mechanics, R.K. Pathria, Pergamon press, Oxford

COURSE PLAN

PROGRAMME	BSc PHYSICS	SEMESTER	5
COURSE TITLE	Digital Electronics	CREDIT	3
Theory HOURS/WEEK	3	HOURS/SEM	54
FACULTY NAME	Dr. Sumod S G		

COURSE OBJECTIVES
Describe the basic understanding of number systems and logic circuits
Use the methods of systematic reduction of Boolean algebra expressions including Karnaugh maps
Explaining the basic sequential and Combinational circuits

SESSION	**TOPIC**	**LEARNING RESOURCES**	**REMARKS**
	MODULE I		
1.	Introduction	Lecture/PPT	
2.	Digital and analog systems	Lecture/PPT	
3.	Importance of Number systems	Lecture/PPT	
4.	Radix and position value	Lecture/PPT	
5.	Conversion of Different number systems-	Lecture/PPT	
6.	Decimal & binary	Lecture/PPT	
7.	octal and hexadecimal	Lecture/PPT	
8.	Addition, Subtraction	Lecture/PPT	
9.	1's complementary method	Lecture/PPT	
10.	2's complementary method	Lecture/PPT	
11.	BCD code, ASCII code	Lecture/PPT	

12.	Primary and Secondary memory	Lecture/PPT	
	MODULE II		
13.	Introduction – Digital electronics	Lect	
14.	Binary logic- AND,OR and NOT operators	PPT and hands on session	
15.	Laws of	Activity	
16.	Boolean algebra- Demorgan's theorem	PPT and hands on session	
17.	Duality theorem	PPT and hands on session	
18.	Boolean functions	Activity	
19.	Complement of a function- Reducing Boolean	PPT and hands on session	
20.	expressions	Activity	
21.	Group Activity	PPT and hands on session	
22.	Problems	Activity	
23.	Canonical and standard	PPT and hands on session	
24.	form	Activity	
25.	CIA-I	PPT and hands on session	
26.	Discussing the CIA problems	PPT and hands on session	
27.	Conversion between truth table,	PPT and hands on session	
28.	Boolean expressions and Logic diagrams	PPT and hands on session	
29.	Simplification of Boolean functions using Karnauh	PPT and hands on session	
30.	map(Two, three and four	PPT and hands on session	

31.	variables)	PPT and hands on session	
32.	XOR, XNOR gates- IC digital logic families	Activity	
33.	Problem Solving Session + NAND, NOR gates	Lecture	
	MODULE III		
34.	Adders- Half Adder	Lecture	
35.	Full Adder circuits- Four bit adder	Lecture	
36.	Subtractor-Half Subtractor. Full subtractor	Lecture	
37.	Multiplexers -2 to 1 multiplexer	Lecture	
38.	Encoders	Lecture	
39.	LED-7 segment Decoder	Lecture	
40.	Decoders	Lecture	
41.	Multiplexer	Lecture	
42.	2 to 1 Multiplexer	Lecture	
43.	16 to 1 Multiplexer	Lecture	
44.	Demultiplexer	Lecture	
45.	1 to 16 Demultiplexer	Lecture	
46.	Flip-flops, RS Flip flop	Lecture	
47.	Clocked RS Flip flop	Lecture	
48.	MSJK FF	Lecture	
49.	DFF JK, T Flip-flop,	Lecture	
50.	Buffer registers- Shift register	Lecture	
51.	Counters- Binary ripple counter-	Lecture	
52.	BCD ripple counter- synchronous binary counter-	Lecture	

53.	Decade counter. D/A converters (Ladder type),	Lecture	
54.	A/D Converter (Counter type)	Lecture	

INDIVIDUAL ASSIGNMENTS/SEMINAR – Details & Guidelines

	Date of completion	Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)
1	Before 1st Internal	Problems of conversion from one to other number system
2	Before 2nd Internal	Problems-Karnough Mapping

Basic Reference:

1. **Digital Design- Morris Mano**
2. **Basic Elecronics – B.L Theraja**

Higher References:

1. Electronic Principles-Sahdev (Dhanpat Rai Co.)
2. Electronic Devices and Circuit Theory-Robert L Boylestad&Louis Nashelsky, PHI
3. Electronic Principles and Applications-Schuler(McGrawHill)
4. Foundations of Electronics-D Chattopadhyay,P.C.Rakshit,B Saha,N.N.Purkait(New Age International Publishers)
5. Principles of Electronics-V.K.Mehta(S.Chand Co.)
6. Electronic Principles-A.P.Malvino 5 th Edition(Tata McGrawHill)
7. Electronic Devices and Circuits-Sajeev Gupta(Dhanpat Rai Publications)
8. Basic Electronics and Linear Circuits-N.N.Bhargava,D.C.Kulshreshtha&S.C.Gupta (Tata McGrawHill)
9. Introduction to Semiconductor Devices, Kevin, Brennan Cambridge Univ. Press
10. Art of Electronics, Thomas C Hayes, Paul Horowitz, Cambridge Univ. Press

Course Plan

PROGRAMME	BACHELOR OF SCIENCE (PHYSICS)	SEMESTER	5
COURSE TITLE	ENERGY AND ENVIRONMENTAL STUDIES	CREDIT	3
HOURS/WEEK	4	HOURS/SEM	72
FACULTY NAME	SIBY MATHEW		

Course Objectives
Understand the various energy sources, particularly the sun and usage of solar energy.
Understand basic ideas on environmental pollution.
Understand the basic ideas of enviromental impact assessment and waste management.

Session	**Topic**	**Method**	**Remarks**
1	World's Reserve Of Energy Sources	Lecture/Discussion	
2	Various Forms Of Energy	Lecture/ discussion	
3	Non Renewable Energy Sources	Seminar/ discussion	
4	Coal,Oil, Natural Gas	Seminar/ discussion	
5	Merits And Demerits Of Non Renewable Energy	Seminar/ discussion	
6	Renewable Energy Sources- Introduction	Seminar/ discussion	
7	Solar Energy	Seminar/ discussion	
8	Biomass Energy	Seminar/ discussion	
9	Biogas Energy	Seminar/ discussion	
10	Wind Energy	Seminar/ discussion	
11	Wave Energy	Seminar/ discussion	

12	Tidal Energy	Seminar/ discussion	
13	Hydro Energy	Seminar/ discussion	
14	Geothermal Energy	Seminar/ discussion	
15	Fusion Energy	Seminar/ discussion	
16	Hydrogen Energy	Seminar/ discussion	
17	Merits And Demerits Of Renewable Energy	Seminar/ discussion	
18	Sun As A Source Of Energy	Lecture/discussion	
19	Solar Radiation	Lecture/discussion	
20	Spectral Distribution	Lecture/discussion	
21	Flat Plate Collector	Lecture/discussion	
22	Solar Water Heating	Lecture/discussion	
23	Different Types Of Solar Water Heaters	Lecture/discussion	
24	Solar Pond - Convective Type	Lecture/discussion	
25	Solar Pond- Salt Gradient Type	Lecture/discussion	
26	Optical Concentrator	Lecture/discussion	
27	Solar Desalination	Lecture/discussion	
28	Solar Dryer- Direct Type	Lecture/discussion	
29	Solar Dryer - Salt Gradient Type	Lecture/discussion	
30	Solar Heating Of Buildings	Lecture/discussion	
31	Solar Green Houses	Lecture/discussion	
32	Solar Photovoltaics	Lecture/discussion	
33	Working Principle Of Solar Cell	Lecture/discussion	

34	Revision	Lecture/discussion	
35	Air Pollution	Lecture/discussion	
36	Water Pollution-Causes	Lecture/discussion	
37	Water Pollution-Control	Lecture/discussion	
38	Soil Pollution -Causes	Lecture/discussion	
39	Soil Pollution -Control	Lecture/discussion	
40	Ground Water Pollution-Causes	Lecture/discussion	
41	Ground Water Pollution -Control	Lecture/discussion	
42	Marine Pollution -Causes	Lecture/discussion	
43	Marine Pollution -Control	Lecture/discussion	
44	Noise Pollution	Lecture/discussion	
45	Nuclear Hazards -1	Lecture/discussion	
46	Nuclear Hazards -2	Lecture/discussion	
47	Pollution, Environmental Hazards -1	Lecture/discussion	
48	Pollution, Environmental Hazards -2	Lecture/discussion	
49	Case Study, Environmental Pollution	discussion	
50	Environmental Impact Assessment - Intro	Lecture/discussion	
51	Environmental Impact Assessment - Steps-1	Lecture/discussion	
52	Environmental Impact Assessment - Steps -2	Lecture/discussion	
53	Environmental Impact Assessment - Case Study	discussion	
54	Pollution Control, General Acts	Lecture/discussion	
55	Water Act	Lecture/discussion	

56	Air Act	Lecture/discussion	
57	Environmental Protection Act	Lecture/discussion	
58	Other Acts	Lecture/discussion	
59	Internal Assessment	exam	
60	Waste Minimization, Source Reduction	Lecture/discussion	
61	Recycling	Lecture/discussion	
62	Conservation	Lecture/discussion	
63	Waste Minimization	Lecture/discussion	
64	Case Study	Lecture/discussion	
65	Hazardous Solid Wastes	Lecture/discussion	
66	Municipal Solid Waste	Lecture/discussion	
67	Biomedical Solid Waste	Lecture/discussion	
68	Waste Treatment And Disposal, Physical Methods	Lecture/discussion	
69	Waste Treatment And Disposal, Chemical Methods	Lecture/discussion	
70	Waste Treatment And Disposal, Biological Methods	Lecture/discussion	
71	Moving Dome Type Biogas Plant	Lecture/discussion	
72	Revision	discussion	

References

1. Essential Environmental Studies S.P Misra, S.N Pandey (Ane Books Pvt Ltd)
2. Environmental Science G Tyler Miller (Cengage Learning)
3. Introduction to Environmental Science Y Anjaneyulu (B S Publications)
4. Introduction to Environmental engineering and science-G.M. Masters andW.P. Ela(PHI Pvt. Ltd)
5. Environmental management-B. Krishnamoorthy (PHI Pvt. Ltd)
6. Solarenergy-fundamentals and applications-H.P. Garg and J. Prakash (TataMc Graw Hill).
7. Solar energy-fundamentals, design, modeling and applications-G.N. Tiwari