SYLLABUS BOOKLET OF

5-YEAR INTEGRATED DUAL DEGREE (B. Tech.-M. Tech.) PROGRAMME IN ENGINEERING PHYSICS

Applicable to Academic Session 2014-15 and onwards

DEPARTMENT UNDERGRADUATE COMMITTEE (DUGC)

DEPARTMENT OF PHYSICS
INDIAN INSTITUTE OF TECHNOLOGY
(BANARAS HINDU UNIVERSITY)
VARANASI-221005

PROGRAMME BOOKLET

1. Introduction of Department/School (250 words)

Institute of Technology was formed in 1968 by merging the colleges known as BENCO, TECHNO and MINMET. Applied Physics section then came into existence with all the physics teachers from these colleges. Department of Applied Physics was created in 1985, and it was renamed as Department of Physics after we became IIT (BHU) on 29 June 2012. This department has a rich legacy as a centre of excellence in various fields, particularly in space sciences with several achievements in addition to teaching. Many research findings were published in the most reputed journals that include 'Nature'. This department is globally recognized for quality research and teaching in Physics & Applied Physics. Today, faculty members are pursuing cutting edge frontline research in various areas in collaboration with prestigious national and international institutes. The department offers excellent research programme in the field of Space Science, Solar Physics, Plasma Physics, Fibre Optics, Photonics & Optoelectronics, Condensed Matter & Materials Physics, Energy Studies, Remote Sensing, Nano-Technology and Biophysics.

Amongst the teaching and training programmes, the department offers a 5-year Integrated M. Tech. course in Engineering Physics. This programme trains the young students in the areas of Physical Sciences, Engineering and Technology. The Department also offers Physics courses (as Institute Science course) to B. Tech/IDD/IMD Part – I students (about 1000 students of all branches of Science & Engineering) and two courses to Preparatory students. Besides the above programmes, Department offers Ph. D. Programme in different specialized areas of physics.

2. Programme Objectives

Department's vision is to cultivate new ideas and innovations in physical sciences. Our mission is to offer world class education, research guidance and also leadership in physical sciences, each at the highest global level.

Main objective of our Engineering Physics programme is to make a good scientist-engineers who should have freedom to build his/her career in the areas of physical sciences and engineering. It also aims at strengthening the scientific foundation of engineering.

3. Overview of Curriculum

In our proposed programme, we have redesigned our course structure under the new UG curriculum review process. The new curriculum is stream-based. At present, we have four streams (Solar & Space Physics; Condensed Matter & Materials Physics; Photonics; Interdisciplinary: Microwave remote Sensing, Energy Studies, and Biophysics). Most of our Departmental core / elective courses are from core physics areas and based on stream. Based

on the expert opinion, we have decided to float basic core physics courses, stream-based courses, and a few suitable courses with engineering content as Departmental core / electives.

Design of this curriculum would help the graduates to pursue PhD in basic physics as well as different engineering streams. Moreover, interested graduates would also be able to consider different Government and private sectors as carrier opportunities. Main Features of this programme are:

1. Basic Institute Science and Institute Engineering Courses at the initial level.
2. Workshop / Manufacturing practice course (First year).
3. Departmental core and practice course (First year).
4. Stream-based (Courses with both Physics & Engineering content) & project-based flexible curriculum.
5. Exploratory project in the 4^{th} Semester.
6. Strong Laboratory Component
7. Relevant courses (related to programme) from other Engineering Departments.
8. Humanities, Language, and Management courses.
9. More options for Departmental Electives.
10. Open Electives from Science / Engineering Department (third year onwards).
11. Project work starts in 3^{rd} year 6^{th} Semester and continues till 4^{th} year 7^{th} semester.
12. Dissertation / Thesis work in the 4^{th} year 8^{th} Semester and 5^{th} year.

Summary of Credit allocation is shown in Table-A

4. Semester-wise course structure as per attached template

A. SEMESTER-WISE COURSE STRUCTURE OF 5-YEAR IDD (Engineering Physics) PROGRAMME (For 2014 Batch)

UG-CRC	Course Code	Course Name	L–T–P			Credits
Section-1BE2	**Engineering Physics: 5-Year IDD I-Semester**					
IS.**PHY102**.14	PHY102	Introduction to Engineering Electromagnetics	3	1	2	13
IS.**CY101**.14	CY101	Chemistry - I	2	1	2	10
IS.**MA101**.14	MA101	Engineering Mathematics - I	3	1	0	11
IE.**ME102**.14	ME102	Engineering Mechanics	3	1	0	11
EP.**ME106**.14	ME106	Manufacturing Practice - II	0	0	3	3
EP.**ME104**.14	ME104	Engineering Drawing	1	0	3	6
IH.**H101**.14	H101	Universal Human Values - I: Self and Family	1	1	0	5
		Total	**13**	**5**	**10**	**59**
LM.**HL101**.14	HL101	Basic English*	2	0	1	7
		Total	**15**	**5**	**11**	**66**
GY.**PE101**.14	PE101	Elementary Physical Education/Creative Practice #	0	1	3	5

L: Lecture hours; T: Tutorial hours; P: Laboratory/ Practical hours; C: Credits

*Students who do not qualify the diagnostic test in English will study Basic English; they will not register for Gymkhana Course. This requirement of Gymkhana Course will be completed in 2nd and 3rd Semester.

UG-CRC	Course Code	Course Name	L–T–P			Credits
Section-1BE2	**Engineering Physics: 5-Year IDD II-Semester**					
IS.**PHY101**.14	PHY101	Classical, Quantum & Relativistic Mechanics	3	1	2	13
IS.**MA102**.14	MA102	Engineering Mathematics – II	3	1	0	11
IE.**EO101**.14	EO101	Fundamentals of Electrical Engineering	3	1	2	13
DC.**EP101**.14	EP101	Modern Physics	2	1	0	8
EP.**EP102**.14	EP102	Practices of Engineering Physics	1	0	3	6
EP.**ME105**.14	ME105	Manufacturing Practice I	0	0	3	3
IH.**H103.**14	H103	(Development of Societies/	2	1	0	8
IH.**H104.**14	H104	History and Civilization)/				
IH.**H105.**14	H105	(Philosophy /				
IH.**H106.**14	H106	Education and Self) *				
		Total	**14**	**5**	**10**	**62**
GY.**PE101**.14	PE101	Elementary Physical Education/Creative Practice #	0	1	3	5

* The students, who have studied course from H103 & H104 group will study course from other H105 & H106 group. Other students will do it other way.
# Students who could not complete the requirement of Gymkhana Courses in first two semesters will do the same in this semester. Students who have done Physical Education Courses will register for any one of the Creative Practice Courses.

UG-CRC	Course Code	Course Name	L–T–P			Credits
Section-2BE2	**Engineering Physics: 5-Year IDD III-Semester**					
IE.**ME103**.14	ME103	Engineering Thermodynamics	3	1	0	11
IE.**CSO101**.14	CSO101	Computer Programming	3	1	2	13
MC.**PHY201**.15	PHY201	Quantum Physics	3	1	0	11
DC.**EO207**.15	EO207	Semiconductor Physics and Devices	2	1	2	10
DC.**EO237**.15	EO237	Fibre Optics	3	0	0	9
IH.**H103.**14	H103	(Development of Societies/	2	1	0	8
IH.**H104.**14	H104	History and Civilization)/				
IH.**H105.**14	H105	(Philosophy /				
IH.**H106.**14	H106	Education and Self) *				
		Total	**16**	**5**	**4**	**62**

* The students, who have studied course from H103 & H104 group will study course from other H105 & H106 group. Other students will do it other way.
# Students who could not complete the requirement of Gymkhana Courses in first two semesters will do the same in this semester. Students who have done Physical Education Courses will register for any one of the Creative Practice Courses.

UG-CRC	Course Code	Course Name	L–T–P			Credits
Section-2BE2	**Engineering Physics: 5-Year IDD IV-Semester**					
IS.**MA203**.14	MA203	Mathematical Methods	3	1	0	11
MC.**EO202**.15	EO202	Analog Circuits and Systems	3	0	3	12
DC.**EP211**.15	EP211	Solar and Space Plasma Physics	3	0	0	9
DC.**EP221**.15	EP221	Condensed Matter Physics	3	0	2	11
DC.**EP201**.15	EP201	Instrumentation, Measurement and Analysis	2	0	0	6
DP.**EP291**.15	EP291	Exploratory Project	0	0	5	5
IH.**H102**.14	H102	Universal Human Value - II (Self, Society and Nature)	1	1	0	5
		Total	**15**	**2**	**10**	**59**
Streams in Engineering Physics						
Stream	Stream Code	Stream Title				
SSP	X1X	Solar and Space Physics				
CMMP	X2X	Condensed Matter and Materials Physics				
PH	X3X	Photonics				
BP	X4X	Biophysics				
ES	X5X	Energy Studies				
RS	X6X	Remote Sensing				

UG-CRC	Course Code	Course Name	L–T–P			Credits
Section-3BE2	**Engineering Physics: 5-Year IDD V-Semester**					
MC.**EO301**.16	EO301	Digital Circuits and Systems	3	0	3	12
DC.**PHY301**.15	PHY301	Atomic and Molecular Physics	3	0	0	9
DC.**PHY302**.15	PHY302	Relativistic Electrodynamics	3	0	0	9
DE-1		Departmental Elective – 1 (*)	3	0	0	9
OE-1		Open Elective - 1	3	0	0	9
HU/LM		#Humanities/Language and Management Course^^	3	0	0	9
		Total	**18**	**0**	**3**	**57**
DP.**EP391**.15	EP391	Stream Project(Hons.)@	0	0	10	10
		total	**18**	**0**	**13**	**67**
***V Semester Elective / Stream DE-1 Courses**						
DE.**EP341**.15	EP341	Introduction to Biophysics	3	0	0	9
DE.**EP351**.15	EP351	Introduction to Renewable Energy Sources	3	0	0	9
DE.**EP361**.15	EP361	Introduction to Remote Sensing	3	0	0	9

^^Three LM courses and Two HU courses should be schedules in these semester totaling 27-31 and 18-22 credits respectively. #Fixed slot of Semester.

UG-CRC	Course Code	Course Name	L–T–P			Credits
Section-3BE2	**Engineering Physics: 5-Year IDD VI-Semester**					
DC.**PHY303**.15	PHY303	Statistical Physics	3	0	0	9
MC.**PHY304**.15	PHY304	Computational Physics	2	0	3	9
DE-2		Departmental Elective – 2 (*)	3	0	0	9
OE-2		Open Elective - 2	3	0	0	9
DP.**EP392**.15	EP392	Stream or UG Project#	0	0	10	10
HU/LM		#Humanities/Language and Management Course^^	3	0	0	9
		Total	**14**	**0**	**13**	**55**
***VI Semester Elective / Stream DE-2 Courses**						
DE.**PHY305**.15	PHY305	Advanced Quantum Mechanics	3	0	0	9
DE.**PHY311**.15	PHY311	Introduction to Astronomy & Astrophysics	3	0	0	9
DE.**PHY321**.15	PHY321	Physics of Materials	3	0	0	9
DE.**EP331**.15	EP331	Advanced Optical fiber & Components	2	0	3	9
DE.**EP342**.15	EP342	Biophysical Techniques	3	0	0	9
DE.**EP362**.15	EP362	Microwave Remote Sensing	2	0	3	9

Section-3BE2	**Engineering Physics: 5-Year IDD Summer Term**					
DP.**EP393**.15	EP393	Project/ Industrial Project/Industrial Training	0	0	0	5
		Total	**0**	**0**	**0**	**5**

UG-CRC	Course Code	Course Name	L–T–P			Credits
Section-4BE2	**Engineering Physics: 5-Year IDD VII-Semester**					
DC.**PHY401**.15	PHY401	Nuclear and Particle Physics	3	0	2	11
DC.**PHY402**.15	PHY402	Quantum Electronics	2	0	0	6
DE-3		Departmental Elective – 3 (*)	3	0	0	9
OE-3		Open Elective - 3	3	0	0	9
DP.**EP491**.15	EP491	Stream or UG Project#	0	0	10	10
HU/LM		#Humanities/Language and Management Course^^	3	0	0	9
		Total	**14**	**0**	**12**	**54**
***VII Semester Elective / Stream DE-3 Courses**						
DE.**PHY403**.15	PHY403	Introduction to Quantum Field Theory	3	0	0	9
DE.**PHY411**.15	PHY411	Magnetohydrodynamics	3	0	0	9
DE.**EP421**.15	EP421	Advanced Materials & Characterization techniques	3	0	0	9
DE.**EP431**.15	EP431	Integrated Optics	3	0	0	9
DE.**EP451**.15	EP451	Non-Conventional Energy Sources	3	0	0	9

UG-CRC	Course Code	Course Name	L–T–P			Credits
Section-4BE2	**Engineering Physics: 5-Year IDD VIII-Semester**					
DE-4		Departmental Elective – 4 (*)	3	0	0	9
DE-5		Departmental Elective – 5 (*)	3	0	0	9
DT.**EP492**.15	EP492	Master Thesis	0	0	10	10
OE - 4		Open Elective - 4	3	0	0	9
HU/LM		#Humanities/Language and Management Course^^	3	0	0	9
		Total	**12**	**0**	**10**	**46**
DT.**EP493**.15	EP493	Stream Project / Thesis (Hons.) @	0	0	10	10
		Total	**12**	**0**	**20**	**56**
***VIII Semester Elective / Stream DE-4, DE-5 Courses**						
DE.**PHY404**.15	PHY404	Phase Transition & Critical Phenomena	3	0	0	9
DE.**PHY412**.15	PHY412	Physics of the Sun and its Atmosphere	3	0	0	9
DE.**PHY421**.15	PHY421	Advanced Condensed Matter Physics	3	0	0	9
DE.**EP432**.15	EP432	Photonics & Optoelectronics	3	0	0	9
DE.**EP441**.15	EP441	Advanced Biophysics	3	0	0	9
DE.**EP452**.15	EP452	Fuel Cell	3	0	0	9
DE.**EP461**.15	EP461	Antenna & Radar Engineering	3	0	0	9

UG-CRC	Course Code	Course Name	L–T–P			Credits
Section-5BE2	**Engineering Physics: 5-Year IDD IX-Semester**					
DE-6		Departmental Elective – 6 (*)	3	0	0	9
DE-7		Departmental Elective – 7 (*)	3	0	0	9
DT.**EP591**.15	EP591	Master Thesis	0	0	10	10
OE - 5		Open Elective - 5	3	0	0	9
OE - 6		Open Elective - 6	3	0	0	9
HU/LM		#Humanities/Language and Management Course^^	3	0	0	9
		Total	**15**	**0**	**10**	**55**
***IX Semester Elective / Stream DE-6 & DE-7 Courses**						
DE.**PHY501**.15	PHY501	Simulation Methods in Statistical Physics	3	0	0	9
DE.**EP511**.15	EP511	Atmospheric Physics & Environmental Sciences	3	0	0	9
DE.**EP512**.15	EP512	Space Weather	3	0	0	9
DE.**PHY521**.15	PHY521	Low Dimensional Physics	3	0	0	9
DE.**PHY531**.15	PHY531	PBG & Meta - Materials	3	0	0	9
DE.**EP561**.15	EP561	Satellite Image Processing	3	0	0	9

UG-CRC	Course Code	Course Name	L–T–P			Credits
Section-5BE2	**Engineering Physics: 5-Year IDD X-Semester**					
DT.**EP592**.15	EP592	Master Thesis	0	0	50	50
		Total	**0**	**0**	**50**	**50**

B. SEMESTER-WISE COURSE STRUCTURE OF 5-YEAR IDD (Engineering Physics) PROGRAMME (For 2015 Batch)

UG-CRC	Course Code	Course Name	L–T–P			Credits
Section-1BE2	**Engineering Physics: 5-Year IDD I-Semester**					
IS.**PHY102**.14	PHY102	Introduction to Engineering Electromagnetics	3	1	2	13
IS.**CY101**.14	CY101	Chemistry - I	2	1	2	10
IS.**MA101**.14	MA101	Engineering Mathematics - I	3	1	0	11
IE.**ME102**.14	ME102	Engineering Mechanics	3	1	0	11
EP.**ME106**.14	ME106	Manufacturing Practice - II	0	0	3	3
EP.**ME104**.14	ME104	Engineering Drawing	1	0	3	6
IH.**H101**.14	H101	Universal Human Values - I: Self and Family	1	1	0	5
		Total	**13**	**5**	**10**	**59**
LM.**HL101**.14	HL101	Basic English*	2	0	1	7
		Total	**15**	**5**	**11**	**66**
GY.**PE101**.14	PE101	Elementary Physical Education/Creative Practice #	0	1	3	5

L: Lecture hours; T: Tutorial hours; P: Laboratory/ Practical hours; C: Credits

*Students who do not qualify the diagnostic test in English will study Basic English; they will not register for Gymkhana Course. This requirement of Gymkhana Course will be completed in 2nd and 3rd Semester.

UG-CRC	Course Code	Course Name	L–T–P			Credits
Section-1BE2	**Engineering Physics: 5-Year IDD II-Semester**					
IS.**PHY101**.14	PHY101	Classical, Quantum & Relativistic Mechanics	3	1	2	13
IS.**MA102**.14	MA102	Engineering Mathematics – II	3	1	0	11
IE.**EO101**.14	EO101	Fundamentals of Electrical Engineering	3	1	2	13
DC.**EP101**.14	EP101	Modern Physics	2	1	0	8
EP.**EP102**.14	EP102	Practices of Engineering Physics	1	0	3	6
EP.**ME105**.14	ME105	Manufacturing Practice I	0	0	3	3
IH.**H103.**14	H103	(Development of Societies/	2	1	0	8
IH.**H104.**14	H104	History and Civilization)/				
IH.**H105.**14	H105	(Philosophy /				
IH.**H106.**14	H106	Education and Self) *				
		Total	**14**	**5**	**10**	**62**
GY.**PE101**.14	PE101	Elementary Physical Education/Creative Practice #	0	1	3	5

* The students, who have studied course from H103 & H104 group will study course from other H105 & H106 group. Other students will do it other way.
# Students who could not complete the requirement of Gymkhana Courses in first two semesters will do the same in this semester. Students who have done Physical Education Courses will register for any one of the Creative Practice Courses.

UG-CRC	Course Code	Course Name	L–T–P			Credits
Section-2BE2	**Engineering Physics: 5-Year IDD III-Semester**					
IE.**ME103**.14	ME103	Engineering Thermodynamics	3	1	0	11
IE.**CSO101**.14	CSO101	Computer Programming	3	1	2	13
MC.**PHY201**.15	PHY201	Quantum Physics	3	1	0	11
DC.**EO207**.15	EO207	Semiconductor Physics and Devices	2	1	2	10
DC.**EO237**.15	EO237	Fibre Optics	3	0	0	9
IH.**H103.**14	H103	(Development of Societies/	2	1	0	8
IH.**H104.**14	H104	History and Civilization)/				
IH.**H105.**14	H105	(Philosophy /				
IH.**H106.**14	H106	Education and Self) *				
		Total	**16**	**5**	**4**	**62**

* The students, who have studied course from H103 & H104 group will study course from other H105 & H106 group. Other students will do it other way.
# Students who could not complete the requirement of Gymkhana Courses in first two semesters will do the same in this semester. Students who have done Physical Education Courses will register for any one of the Creative Practice Courses.

UG-CRC	Course Code	Course Name	L–T–P			Credits
Section-2BE2	**Engineering Physics: 5-Year IDD IV-Semester**					
IS.**MA203**.14	MA203	Mathematical Methods	3	1	0	11
MC.**EO202**.15	EO202	Analog Circuits and Systems	3	0	3	12
DC.**PHY211**.15	PHY211	Solar and Space Plasma Physics	3	0	0	9
DC.**PHY221**.15	PHY221	Condensed Matter Physics	3	0	2	11
DC.**EP201**.15	EP201	Instrumentation, Measurement and Analysis	2	0	0	6
DP.**EP291**.15	EP291	Exploratory Project	0	0	5	5
IH.**H102**.14	H102	Universal Human Value - II (Self, Society and Nature)	1	1	0	5
		Total	**15**	**2**	**10**	**59**
Streams in Engineering Physics						
Stream	Stream Code	Stream Title				
SSP	X1X	Solar and Space Physics				
CMMP	X2X	Condensed Matter and Materials Physics				
PH	X3X	Photonics				
BP	X4X	Biophysics				
ES	X5X	Energy Studies				
RS	X6X	Remote Sensing				

UG-CRC	Course Code	Course Name	L–T–P			Credits
Section-3BE2	**Engineering Physics: 5-Year IDD V-Semester**					
MC.**EO301**.16	EO301	Digital Circuits and Systems	3	0	3	12
DC.**PHY301**.15	PHY301	Atomic and Molecular Physics	3	0	0	9
DC.**PHY302**.15	PHY302	Relativistic Electrodynamics	3	0	0	9
DE-1		Departmental Elective – 1 (*)	3	0	0	9
OE-1		Open Elective - 1	3	0	0	9
HU/LM		#Humanities/Language and Management Course^^	3	0	0	9
		Total	**18**	**0**	**3**	**57**
DP.**EP391**.15	EP391	Stream Project(Hons.)@	0	0	10	10
		total	**18**	**0**	**13**	**67**
***V Semester Elective / Stream DE-1 Courses**						
DE.**EP341**.15	EP341	Biophysics	3	0	0	9
DE.**EP351**.15	EP351	Renewable Energy Sources	3	0	0	9
DE.**EP361**.15	EP361	Remote Sensing	3	0	0	9

^^Three LM courses and Two HU courses should be schedules in these semester totaling 27-31 and 18-22 credits respectively. #Fixed slot of Semester.

UG-CRC	Course Code	Course Name	L–T–P			Credits
Section-3BE2	**Engineering Physics: 5-Year IDD VI-Semester**					
DC.**PHY303**.15	PHY303	Statistical Physics	3	0	0	9
MC.**PHY304**.15	PHY304	Computational Physics	2	0	3	9
DE-2		Departmental Elective – 2 (*)	3	0	0	9
OE-2		Open Elective - 2	3	0	0	9
DP.**EP392**.15	EP392	Stream or UG Project#	0	0	10	10
HU/LM		#Humanities/Language and Management Course^^	3	0	0	9
		Total	**14**	**0**	**13**	**55**
***VI Semester Elective / Stream DE-2 Courses**						
DE.**PHY305**.15	PHY305	Advanced Quantum Mechanics	3	0	0	9
DE.**PHY311**.15	PHY311	Introduction to Astronomy & Astrophysics	3	0	0	9
DE.**PHY321**.15	PHY321	Physics of Materials	3	0	0	9
DE.**EP331**.15	EP331	Advanced Optical fiber & Components	2	0	3	9
DE.**EP342**.15	EP342	Biophysical Techniques	3	0	0	9
DE.**EP362**.15	EP362	Microwave Remote Sensing	2	0	3	9

Section-3BE2	**Engineering Physics: 5-Year IDD Summer Term**					
DP.**EP393**.15	EP393	Project/ Industrial Project/Industrial Training	0	0	0	5
		Total	**0**	**0**	**0**	**5**

UG-CRC	Course Code	Course Name	L–T–P			Credits
Section-4BE2	**Engineering Physics: 5-Year IDD VII-Semester**					
DC.**PHY401**.15	PHY401	Nuclear and Particle Physics	3	0	2	11
DC.**PHY402**.15	PHY402	Quantum Electronics	2	0	0	6
DE-3		Departmental Elective – 3 (*)	3	0	0	9
OE-3		Open Elective - 3	3	0	0	9
DP.**EP491**.15	EP491	Stream or UG Project#	0	0	10	10
HU/LM		#Humanities/Language and Management Course^^	3	0	0	9
		Total	**14**	**0**	**12**	**54**
***VII Semester Elective / Stream DE-3 Courses**						
DE.**PHY403**.15	PHY403	Introduction to Quantum Field Theory	3	0	0	9
DE.**PHY411**.15	PHY411	Magnetohydrodynamics	3	0	0	9
DE.**EP421**.15	EP421	Advanced Materials & Characterization techniques	3	0	0	9
DE.**EP431**.15	EP431	Integrated Optics	3	0	0	9
DE.**EP451**.15	EP451	Non-Conventional Energy Sources	3	0	0	9

UG-CRC	Course Code	Course Name	L–T–P			Credits
Section-4BE2	**Engineering Physics: 5-Year IDD VIII-Semester**					
DE-4		Departmental Elective – 4 (*)	3	0	0	9
DE-5		Departmental Elective – 5 (*)	3	0	0	9
DT.**EP492**.15	EP492	Master Thesis	0	0	10	10
OE - 4		Open Elective - 4	3	0	0	9
HU/LM		#Humanities/Language and Management Course^^	3	0	0	9
		Total	**12**	**0**	**10**	**46**
DT.**EP493**.15	EP493	Stream Project / Thesis (Hons.) @	0	0	10	10
		Total	**12**	**0**	**20**	**56**
***VIII Semester Elective / Stream DE-4, DE-5 Courses**						
DE.**PHY404**.15	PHY404	Phase Transition & Critical Phenomena	3	0	0	9
DE.**PHY412**.15	PHY412	Physics of the Sun and its Atmosphere	3	0	0	9
DE.**PHY421**.15	PHY421	Advanced Condensed Matter Physics	3	0	0	9
DE.**EP432**.15	EP432	Photonics & Optoelectronics	3	0	0	9
DE.**EP441**.15	EP441	Advanced Biophysics	3	0	0	9
DE.**EP452**.15	EP452	Fuel Cell	3	0	0	9
DE.**EP461**.15	EP461	Antenna & Radar Engineering	3	0	0	9

UG-CRC	Course Code	Course Name	L–T–P			Credits
Section-5BE2	**Engineering Physics: 5-Year IDD IX-Semester**					
DE-6		Departmental Elective – 6 (*)	3	0	0	9
DE-7		Departmental Elective – 7 (*)	3	0	0	9
DT.**EP591**.15	EP591	Master Thesis	0	0	10	10
OE - 5		Open Elective - 5	3	0	0	9
OE - 6		Open Elective - 6	3	0	0	9
HU/LM		#Humanities/Language and Management Course^^	3	0	0	9
		Total	**15**	**0**	**10**	**55**
***IX Semester Elective / Stream DE-6 & DE-7 Courses**						
DE.**PHY501**.15	PHY501	Simulation Methods in Statistical Physics	3	0	0	9
DE.**EP511**.15	EP511	Atmospheric Physics & Environmental Sciences	3	0	0	9
DE.**EP512**.15	EP512	Space Weather	3	0	0	9
DE.**PHY521**.15	PHY521	Low Dimensional Physics	3	0	0	9
DE.**PHY531**.15	PHY531	PBG & Meta - Materials	3	0	0	9
DE.**EP561**.15	EP561	Satellite Image Processing	3	0	0	9

UG-CRC	Course Code	Course Name	L–T–P			Credits
Section-5BE2	**Engineering Physics: 5-Year IDD X-Semester**					
DT.**EP592**.15	EP592	Master Thesis	0	0	50	50
		Total	**0**	**0**	**50**	**50**

C. SEMESTER-WISE COURSE STRUCTURE OF 5-YEAR IDD (Engineering Physics) PROGRAMME (For 2016 onwards)

UG-CRC	Course Code	Course Name	L–T–P			Credits
Section-1BE2	**Engineering Physics: 5-Year IDD I-Semester**					
IS.**PHY102**.14	PHY102	Introduction to Engineering Electromagnetics	3	1	2	13
IS.**CY101**.14	CY101	Chemistry - I	2	1	2	10
IS.**MA101**.14	MA101	Engineering Mathematics - I	3	1	0	11
IE.**CSO101**.14	CSO101	Computer Programming	3	1	2	13
EP.**ME106**.14	ME106	Manufacturing Practice - II	0	0	3	3
EP.**ME104**.14	ME104	Engineering Drawing	1	0	3	6
IH.**H101**.14	H101	Universal Human Values - I: Self and Family	1	1	0	5
		Total	**13**	**5**	**12**	**61**
LM.**HL101**.14	HL101	Basic English*	2	0	1	7
		Total	**15**	**5**	**13**	**68**
GY.**PE101**.14	PE101	Elementary Physical Education Creative Practice	0 0	1 1	3 3	5 5

L: Lecture hours; T: Tutorial hours; P: Laboratory/ Practical hours; C: Credits
*Students who do not qualify the diagnostic test in English will study Basic English

UG-CRC	Course Code	Course Name	L–T–P			Credits
Section-1BE2	**Engineering Physics: 5-Year IDD II-Semester**					
IS.**PHY101**.14	PHY101	Classical, Quantum & Relativistic Mechanics	3	1	2	13
IS.**MA102**.14	MA102	Engineering Mathematics – II	3	1	0	11
IE.**ME102**.14	ME102	Engineering Mechanics	3	1	0	11
DC.**PHY103**.14	PHY103	Modern Physics	2	1	0	8
EP.**EP101**.14	EP101	Practices of Engineering Physics	1	0	3	6
EP.**ME105**.14	ME105	Manufacturing Practice I	0	0	3	3
IH.**H105.**14	H105	(Philosophy /	2	1	0	8
IH.**H106.**14	H106	Education and Self) *				
		Total	**14**	**5**	**8**	**60**

* The students, who have studied course from H103 & H104 group will study course from other H105 & H106 group. Other students will do it other way.

UG-CRC	Course Code	Course Name	L–T–P			Credits
Section-2BE2	**Engineering Physics: 5-Year IDD III-Semester**					
IE.**CHO102**.14	CHO102	Fluid Mechanics	3	1	0	11
IE.**EO101**.14	EO101	Fundamentals of Electrical Engineering	3	1	2	13
MC.**PHY201**.15	PHY201	Quantum Physics	3	1	0	11
DC.**EC201**.14	EC201	Solid State Electronic Devices	3	0	3	12
DC.**EO237**.15	EO237	Fibre Optics	3	0	0	9
IH.**H103.**14	H103	(Development of Societies/	2	1	0	8
IH.**H104.**14	H104	History and Civilization)/				
		Total	**17**	**4**	**5**	**64**

* The students, who have studied course from H103 & H104 group will study course from other H105 & H106 group. Other students will do it other way.

UG-CRC	Course Code	Course Name	L–T–P			Credits
Section-2BE2	**Engineering Physics: 5-Year IDD IV-Semester**					
IS.**MA203**.14	MA203	Mathematical Methods	3	1	0	11
MC.**EO202**.15	EO202	Analog Circuits and Systems	3	0	3	12
DC.**EP201**.15	EP201	Instrumentation, Measurement and Analysis	2	0	0	6
DC.**PHY211**.15	PHY211	Solar and Space Plasma Physics	3	0	0	9
DC.**PHY221**.15	PHY221	Condensed Matter Physics	3	0	2	11
DP.**EP291**.15	EP291	Exploratory Project	0	0	5	5
IH.**H102**.14	H102	Universal Human Value - II (Self, Society and Nature)	1	1	0	5
		Total	**15**	**2**	**10**	**59**
Streams in Engineering Physics						
Stream	Stream Code	Stream Title				
SSP	X1X	Solar and Space Physics				
CMMP	X2X	Condensed Matter and Materials Physics				
PH	X3X	Photonics				
BP	X4X	Biophysics				
ES	X5X	Energy Studies				
RS	X6X	Remote Sensing				

UG-CRC	Course Code	Course Name	L–T–P			Credits
Section-3BE2	**Engineering Physics: 5-Year IDD V-Semester**					
MC.**EO301**.16	EO301	Digital Circuits and Systems	3	0	3	12
DC.**PHY301**.15	PHY301	Atomic and Molecular Physics	3	0	0	9
DC.**PHY302**.15	PHY302	Relativistic Electrodynamics	3	0	0	9
DE-1		Departmental Elective – 1 (*)	3	0	0	9
OE-1		Open Elective - 1	3	0	0	9
HU/LM		#Humanities/Language and Management Course^^	3	0	0	9
		Total	**18**	**0**	**3**	**57**
DP.**EP391**.15	EP391	Stream Project (Hons.) @	0	0	10	10
		Total	**18**	**0**	**13**	**67**
***V Semester Elective / Stream DE-1 Courses**						
DE.**EP341**.15	EP341	Biophysics	3	0	0	9
DE.**EP351**.15	EP351	Renewable Energy Sources	3	0	0	9
DE.**EP361**.15	EP361	Remote Sensing	3	0	0	9

^^Three LM courses and Two HU courses should be schedules in these semester totaling 27-31 and 18-22 credits respectively. #Fixed slot of Semester.

UG-CRC	Course Code	Course Name	L–T–P			Credits
Section-3BE2	**Engineering Physics: 5-Year IDD VI-Semester**					
DC.**PHY303**.15	PHY303	Statistical Physics	3	0	0	9
MC.**PHY304**.15	PHY304	Computational Physics	2	0	3	9
DE-2		Departmental Elective – 2 (*)	3	0	0	9
OE-2		Open Elective - 2	3	0	0	9
DP.**EP392**.15	EP392	Stream or UG Project#	0	0	10	10
HU/LM		#Humanities/Language and Management Course^^	3	0	0	9
		Total	**14**	**0**	**13**	**55**
***VI Semester Elective / Stream DE-2 Courses**						
DE.**PHY305**.15	PHY305	Advanced Quantum Mechanics	3	0	0	9
DE.**PHY311**.15	PHY311	Introduction to Astronomy & Astrophysics	3	0	0	9
DE.**PHY321**.15	PHY321	Physics of Materials	3	0	0	9
DE.**EP331**.15	EP331	Advanced Optical fiber & Components	2	0	3	9
DE.**EP342**.15	EP342	Biophysical Techniques	3	0	0	9
DE.**EP362**.15	EP362	Microwave Remote Sensing	2	0	3	9

Section-3BE2	**Engineering Physics: 5-Year IDD Summer Term**					
DP.**EP393**.15	EP393	Project/ Industrial Project/Industrial Training	0	0	0	5
		Total	**0**	**0**	**0**	**5**

UG-CRC	Course Code	Course Name	L–T–P			Credits
Section-4BE2	**Engineering Physics: 5-Year IDD VII-Semester**					
DC.**PHY401**.15	PHY401	Nuclear and Particle Physics	3	0	2	11
DC.**PHY402**.15	PHY402	Quantum Electronics	2	0	0	6
DE-3		Departmental Elective – 3 (*)	3	0	0	9
OE-3		Open Elective - 3	3	0	0	9
DP.**EP491**.15	EP491	Stream or UG Project#	0	0	10	10
HU/LM		#Humanities/Language and Management Course^^	3	0	0	9
		Total	**14**	**0**	**12**	**54**
***VII Semester Elective / Stream DE-3 Courses**						
DE.**PHY403**.15	PHY403	Introduction to Quantum Field Theory	3	0	0	9
DE.**PHY411**.15	PHY411	Magnetohydrodynamics	3	0	0	9
DE.**EP421**.15	EP421	Advanced Materials & Characterization techniques	3	0	0	9
DE.**EP431**.15	EP431	Integrated Optics	3	0	0	9
DE.**EP451**.15	EP451	Non-Conventional Energy Sources	3	0	0	9

UG-CRC	Course Code	Course Name	L–T–P			Credits
Section-4BE2	**Engineering Physics: 5-Year IDD VIII-Semester**					
DE-4		Departmental Elective – 4 (*)	3	0	0	9
DE-5		Departmental Elective – 5 (*)	3	0	0	9
DT.**EP492**.15	EP492	Master Thesis	0	0	10	10
OE - 4		Open Elective - 4	3	0	0	9
HU/LM		#Humanities/Language and Management Course^^	3	0	0	9
		Total	**12**	**0**	**10**	**46**
DT.**EP493**.15	EP493	Stream Project / Thesis (Hons.) @	0	0	10	10
		Total	**12**	**0**	**20**	**56**
***VIII Semester Elective / Stream DE-4, DE-5 Courses**						
DE.**PHY404**.15	PHY404	Phase Transition & Critical Phenomena	3	0	0	9
DE.**PHY412**.15	PHY412	Physics of the Sun and its Atmosphere	3	0	0	9
DE.**PHY421**.15	PHY421	Advanced Condensed Matter Physics	3	0	0	9
DE.**EP432**.15	EP432	Photonics & Optoelectronics	3	0	0	9
DE.**EP441**.15	EP441	Advanced Biophysics	3	0	0	9
DE.**EP452**.15	EP452	Fuel Cell	3	0	0	9
DE.**EP461**.15	EP461	Antenna & Radar Engineering	3	0	0	9

UG-CRC	Course Code	Course Name	L–T–P			Credits
Section-5BE2	**Engineering Physics: 5-Year IDD IX-Semester**					
DE-6		Departmental Elective – 6 (*)	3	0	0	9
DE-7		Departmental Elective – 7 (*)	3	0	0	9
DT.**EP591**.15	EP591	Master Thesis	0	0	10	10
OE - 5		Open Elective - 5	3	0	0	9
OE - 6		Open Elective - 6	3	0	0	9
HU/LM		#Humanities/Language and Management Course^^	3	0	0	9
		Total	**15**	**0**	**10**	**55**
***IX Semester Elective / Stream DE-6 & DE-7 Courses**						
DE.**PHY501**.15	PHY501	Simulation Methods in Statistical Physics	3	0	0	9
DE.**EP511**.15	EP511	Atmospheric Physics & Environmental Sciences	3	0	0	9
DE.**EP512**.15	EP512	Space Weather	3	0	0	9
DE.**PHY521**.15	PHY521	Low Dimensional Physics	3	0	0	9
DE.**PHY531**.15	PHY531	PBG & Meta - Materials	3	0	0	9
DE.**EP561**.15	EP561	Satellite Image Processing	3	0	0	9

UG-CRC	Course Code	Course Name	L–T–P			Credits
Section-5BE2	**Engineering Physics: 5-Year IDD X-Semester**					
DT.**EP592**.15	EP592	Master Thesis	0	0	50	50
		Total	**0**	**0**	**50**	**50**

SUMMARY OF CREDIT ALLOCATION (Table-A)				
S. No.	**Cat.**	**Programme Components**	**Prescribed**	**Allocated**
1.	HU	Humanities and Social Science*	4-5 (41-46)	6 (44)
2.	IS	Science*	6-7 (62-84)	6 (69)
3.	IE	Institute Requirement Engineering/ Pharmacy*	4-5 (41-60)	4 (48)
4.	EP	Engineering Drawing (Manual and Computer Aided), Manufacturing Practices and Practice course of Department/ School*	2 (20-24)	4 (18)
5.	LM	Language and Management*	2-3 (27-31)	3 (27)
6.	DC/MC	Department/Programme Core (Includes Stream Courses)	10-13 (105-155)	15(143)
7.	DE/BE	Department/Programme Elective (Includes Stream Courses)	6-8 (60-90)	7(63)
8.	OE	Open Elective (Interdisciplinary Stream courses from Science/ Engineering/Pharmacy) (Room for Minor with some additional Credits)	5-8 (55-100)	6 (54)
9.	DP	Project/ Industrial visit/ Training	5-10 unit (20-50)	4 (30) (6 Unit)
10.	DT	Dissertation	14-16 unit (70-80)	3 (70) (14 Unit)
				566

* Institute Requirements

Department Programme Core (DC) Courses also include Multi-Departmental Core Courses (MC)

Department Programme Elective (DE) Courses also include Bouquet Elective (BE) Courses

DETAILED SYLLABI OF 5-YEAR IDD (ENGG. PHYS) PROGRAMME
(Courses are arranged as per 2016 Course Structure)

SEMESTER-I

INTRODUCTION TO ENGINEERING ELECTROMAGNETICS

1. GENERAL

1.1 COURSE TITLE: Introduction to Engineering Electromagnetics
1.2 *COURSE NUMBER: IS**.PHY 102.**14
1.3 CONTACT HRS: 3-1-2, Credits 13
1.4 *SEMESTER -OFFERED: Both
1.5 PRE-REQUISITE: None
1.6 SYLLABUS COMMITTEE MEMBERS: Dr. (Mrs.) A. Mohan (Convener), Prof. B. N. Dwivedi, Prof. D. Giri, Prof. P. Singh, Prof. R. Prasad, Dr. A.K. Srivastava.

2. OBJECTIVE

This novel course is designed to cater to the needs of foundation in modern technology.

3. COURSE CONTENT

UNIT I: Physical concepts of vector operators: (4 Lectures)

Gradient, Divergence and Curl. Scalar and Vector fields, Gauss' divergence theorem, and Stokes' theorem.

UNIT II: Axiomatic treatment of Maxwell's equations: (10 Lectures)

Continuity equation, Displacement current, Velocity-independent and Velocity-dependent potentials. Poisson and Laplace equations and their applications.

UNIT III: Electromagnetism: (13 Lectures)

Ampère's law. Faraday's law of induction. Lorentz force and modified form of Ohm's law. Electromagnetic lenses. Physical significance of magnetic vector potential. Electric and magnetic energy densities. Electromagnetic wave equations in terms of electric field and magnetic field, and also in terms of magnetic vector potentialand electric scalar potential in free space and in a medium with their solutions. Coulomb gauge, Lorentz gauge and gauge transformations. Energy flow in an electromagnetic field: Poynting vector and Poynting theorem.

UNIT IV: Electromagnetic waves in different media: (5 Lectures)

Propagation of electromagnetic waves in free space, Dielectric and Conducting media. Reflection and transmission of electromagnetic waves at interfaces. Fresnel's equations, and Brewster's law.

UNIT V: Some illustrations: (6 Lectures)

Interference, Diffraction, and Polarization of electromagnetic waves. Their applications in the visible range of the electromagnetic spectrum.

4. READINGS

4.1 TEXT BOOKS:

1. Electromagnetic Fields and Waves by Paul Lorrain, Dale R. Corson and Francois Lorrain
2. Introduction to Electrodynamics by David J. Griffiths
3. Engineering Electromagnetics by William H Hayt
4. Electricity and Magnetism by M.H. Nayfeh and M.K. Brussel

4.2 *REFERENCE BOOKS:

1. Feynman Lectures on Physics, Volume II

5. OUTCOME OF THE COURSE

Every student in Engineering & Technology will be able to appreciate the content and quality of topics being covered in his branch.

CHEMISTRY-I

1. GENERAL

1.1 COURSE TITLE: Chemistry – I

1.2 *COURSE NUMBER: IS**.CY 101.**14

1.3 CONTACT HRS: 2-1-2, Credits 10

1.4 *SEMESTER -OFFERED: Odd Semester

1.5 PREREQUISITE: None

1.6 SYLLABUS COMMITTEE MEMBERS: Prof. Y. C. Sharma, (Convener), Dr. I. Sinha, Dr. Manisha Malviya.

2. COURSE CONTENT

UNIT I: Titrimetric Analysis (4 Lectures)

Introduction to titrimetric analysis; acid-base, Redox and complexometric titrations.

UNIT II:Coordination Chemistry (5 Lectures)

General introduction to ligands and complexes, Crystal field theory as applicable to metal complexes, Crystal field splitting in octahedral and tetrahedral complexes, Factors affecting crystal field parameter, Jahn-Teller distortion, Square planar complexes, Colour of complexes.

UNIT III: Organic Reaction Mechanisms (5 Lectures)

Nucleophilic Substitution Reactions: Brief review of nucleophilic substitution reactions at saturated carbon atom, Substitution reactions at allylic substrates, Mechanisms and stereochemistry of SNi and Neighbouring group participation reactions, Factors affecting nucleophilic substitution reactions.

UNIT IV: Elimination Reactions (4 Lectures)

Mechanism of E1 and E1cb reactions. Mechanism and stereochemistry of E2 reactions, anti, syn and pyro Elimination reactions, Mechanism and stereochemistry of electrophilic addition reaction.

UNIT V: Chemical Kinetics (5 Lectures)

Concepts of rate, rate constant, Order and molecularity of elementary and multi-step reactions, First and second-order reactions, determination of rate law, reversible reactions, concurrent and consecutive reactions first order reactions.

UNIT VI: Photochemistry (4 Lectures)

Laws of photochemistry, Quantum yield, experimental determination of quantum yield, Kinetics of photochemical reactions (simple and chain reactions), Photo-physical processes: fluorescence, phosphorescence (with spectroscopic consideration), Photosensitization.

3. RECOMMENDED BOOKS

1. F. A. Cotton, G. Wilkinson, C.A. Murillo and M. Bochmann, Advanced Inorganic Chemistry, John Wiley, 6th Ed., 1999.
2. Ellen A Keiter, James E. Huheey, Okhil K. Medhi, Richard L. Keiter, Inorganic Chemistry: principles of structure and reactivity, 4th Ed., Pearson Education, 2012.
3. J.D. Lee, Concise Inorganic Chemistry, 5th Ed., Wiley India Pvt. Ltd.
4. Vogel's text book of Quantitative chemical Analysis, revised by G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denny, Longman, UK.
5. Ira N. Levine, Physical Chemistry, Tata McGraw Hill.
6. R. A. Alberty and R. J. Silbey, Physical Chemistry, John Wiley & Sons.
7. G. W. Castellan, Physical Chemistry, Narosa Publishing House.
8. R.T. Morrison and R. N. Boyd, Text book of Organic Chemistry, Prentice Hall, New Delhi, 6th edition, 1992,
9. P. Sykes, Guide book to Reaction Mechanism in Organic Chemistry, Longman, London, 6th edition, 1996.
10. T.W.G. Solomon, C.B. Fryhle Organic Chemistry, John Wiley & sons, New York. 8th edition, 2004.

ENGINEERING MATHEMATICS – I

1. GENERAL

1.1 COURSE TITLE: Engineering Mathematics - I

1.2 *COURSE NUMBER: IS**.MA 101.**14

1.3 CONTACT HRS: 3-1-0, Credits 11

1.4 *SEMESTER-OFFERED: Both

1.5 PREREQUISITE: None

1.6 SYLLABUS OF COMMITTEE MEMBER: Prof. T. Som (Convener), Dr. V.K. Singh

2. COURSE CONTENT

UNIT I: 1 Sequences and Continuous Functions (10 Lectures)

Real number system: Completeness axiom, density of rationals (irrationals) in R, Convergence of a sequence, Sandwich theorem, Monotone sequences.

Limits and Continuity of functions, Intermediate value property, Differentiability, Necessary condition for local maxima, Rolle's theorem and Mean value theorem, Cauchy mean value theorem, L'Hospital rule, Increasing and decreasing functions, Convexity, Second derivative test for max and min, Point of inflection, curve sketching.

UNIT II: 2 Power Series Expansions (4 Lectures)

Taylor's theorem with remainder, Convergence of series, Absolute convergence, Comparison test, Ratio test, Root test, Power series, Radius of convergence, Taylor series, Maclaurin series.

UNIT III: 3 Riemann Integration, Surface Area & Volume (7 Lectures)

Introduction to Riemann integration, Elementary properties of integral, Fundamental Theorems of calculus, Improper integral of first & second kind, Comparison test, Absolute convergence, Applications of definite integral: Polar coordinates, Graphs in polar coordinates, Area between two curves when their equations are given in polar coordinates, Volumes by slicing, Length of a curve.

UNIT IV: 4 Multi-variable Calculus (6 Lectures)

Functions of several variables, Continuity, Partial derivatives, Total derivative, Increment theorem, Chain rule, Gradient, Directional derivatives, Tangent plane and Normal line, Mixed derivative theorem, Necessary and sufficient conditions for Maxima, Minima and Saddle point, The method of Lagrange multipliers.

UNIT V: Vector Calculus (4Lectures)

Review of vector algebra, Equations of lines and planes, Continuity and Differentiability of vector functions, Arc length for space curves, Unit tangent vector, Unit normal and Curvature to plane and space curves,

UNIT VI: Multiple Integrals (8 Lectures)

Double integral, Fubini's theorem, Volumes and Areas, Change of variable in a double integral, special case: Polar coordinates, Triple integral, Applications, Change of variables in a triple integral, Surface area, Surface area (contd.), Line integrals, Surface integrals, Green's Theorem, Vector fields, Divergence and Curl of a vector field, Stokes' Theorem, The divergence theorem.

3. READINGS

3.1 TEXTBOOK:

3.2 REFERENCE BOOKS: Calculus by Thomas and Finney.

COMPUTER PROGRAMMING

1. GENERAL

1.1 COURSE TITLE: Computer Programming

1.2 *COURSE NUMBER: IE.**CSO101**.14

1.3 CONTACT HRS: 3-1-2, Credits 13

1.4 *SEMESTER -OFFERED: Both

1.5 PREREQUISITE: None

1.5 SYLLABUS OF COMMITTEE MEMBER: Prof. S.K. Pandey (Convener), Dr. Rajeev Srivastava, Dr. Ravi Shankar Singh, Prof. L.P. Singh, Prof. S. Mukhapadhyay, Dr. Subir Das, Prof. B.N. Sharma, Prof. R.K. Mishra, Dr. P. Ghosh.

2. OBJECTIVE

1. To introduce problem solving methods and algorithm development.
2. To teach programming language C.
3. To teach how to design, code, debug and document programs using techniques of good programming style.

3. COURSE CONTENT

UNIT I: (10 Lectures)

Programming Language C and programming: Basic Syntax and Semantics, Variables, Types, Expressions, Assignment statements, Conditional and Iterative Control Structures.

UNIT II: (10 Lectures)

Simple I/O, Functions and parameter passing, Strings and string processing, Pointers and References, Structures, Recursion.

UNIT III: (19 Lectures)

Algorithm development: Techniques of problem solving, Stepwise Refinement, Simple numerical examples, algorithms for searching and sorting, merging order lists. Examples taken from such areas as business applications involving data manipulation, and simulation involving games.

4. OUTCOME OF THE COURSE

1. Analyze and explain the behaviour of simple programs involving the fundamental programming constructs.
2. Modify and expand short programs that use standard conditional and iterative controls structures and functions.
3. Design, implement, test and debug a program that uses each of fundamental programming constructs.
4. Apply the technique of structured decomposition to break a program into smaller pieces.

MANUFACTURING PRACTICE I & II

1. GENERAL

1.1 COURSE TITLE: Manufacturing Practice I & II

1.2 *COURSE NUMBER: EP**.ME 105.**14**&**EP**.ME 106.**14

1.3 CONTACT HRS: 0-0-3, Credits 3

1.4 *SEMESTER -OFFERED: Both

1.5 SYLLABUS COMMITTEE MEMBER: Prof. A. K. Jha (Convener), Prof. Santosh Kumar, Dr. M.Z. Khan Yusufzai, Dr. M. Vashista (ME)

2. OBJECTIVES

To make the students familiar with various manufacturing processes and to get an on hand experience on these processes. Impart practical knowledge about the capabilities of manufacturing processes and how these processes could be used to produce various types of components and products.

3. DELIVERABLES

To develop skill and confidence among the students to successfully use various manufacturing processes and to understand the difficulties faced by the personnel working on these manufacturing processes

4. PRACTICE PLAN

1. **Manufacturing Practice I (Total hours: 3 hours per week x 10 weeks=30 Hours)**

a. Foundry **(1 turn)**

b. Pattern Making **(1 turn)**

c. Material joining and Deposition Processes **(2 turns)**

d. Metal forming processes **(1 turn)**

e. Demonstration of Videos on Manufacturing Processes **(1 turn)**

f. Project work-I **(4 turns)**

2. Manufacturing Practice II (Total hours: 3 hours per week x 10 weeks=30 Hours)

a. Centre Lathe **(1 turns)**

b. Fitting **(1 turn)**

c. Milling **(1 turn)**

d. Shaping **(1 turn)**

e. CNC **(1 turn)**

f. Demonstration of Videos on Manufacturing Processes **(1 turn)**

g. **Project work-II (4 turns)**

Note: (i) 1 turn means contact duration of three hours

(ii) Project work I & II may be combined into a larger project 36

5. SYLLABUS

1. **Manufacturing Practice I** EP.**ME 105.**14

a. Foundry: Demonstration of foundry tools, equipments and furnaces, Preparation of simple sand moulds along with the gating system and risers.

b. Pattern Making: Importance of woodworking Demonstration of carpentry tools, equipments, carpentry processes and wood working joints. Preparation of single piece pattern.

c. Material joining and Deposition Processes: Classification of various welding and joining processes, types of welding joints, Demonstration of gas welding, arc welding, resistance welding. Practice of manual metal arc welding process.

Demonstration of setup for electroplating process details and safety requirements. Practice of copper and nickel plating of mild steel samples.

d. Metal forming processes: Demonstration of black smithy tools and equipments. Hot and cold working. Practice of open die forging process. Sheet metal material, tools and machines. Sheet metal joints. Practice of preparing a sheet metal component having joint.

e. Demonstration of Videos on Manufacturing Processes

f. Project work-I: Preparation of a real life job using the processes practiced in manufacturing practice I.

2. Manufacturing Practice II EP**.ME 106.**14

a. Centre Lathe: Classification and types of lathe, parts and components of a lathe. Demonstration of various turning operation. Practice of a few turning operations on a centre lathe. Cutting tool.

b. Fitting: Demonstration of various types of files, saws, marking and clamping tools. Drilling and tapping. Practice of a assembling and fitting a job.

c. Milling: Classification and types of milling machines, parts and components of a milling machine. Milling cutter, Indexing and gear cutting.

d. Shaping: Parts and components of a shaper and planer. Quick return mechanism. Practice on preparing component using shaper

e. CNC: Specifications of a CNC Machine, difference between a conventional machine and CNC Machines. Types of CNC Machine. Basics of CNC Programming. Writing a CNC program and executing it on a CNC Machine.

f. Demonstration of Videos on Manufacturing Processes

g. Project work-II: Preparation of a real life job using the processes practiced in manufacturing practice II.

6. READING BOOKS

1. Workshop Technology in SI Units (Part - 1) Author: W. A. J. Chapman, Publisher: CBS Publications.
2. Workshop Technology in SI Units (Part - 2) Author: W. A. J. Chapman, Publisher: CBS Publications.
3. Workshop Technology in SI Units (Part - 3) Author: W. A. J. Chapman, Publisher: CBS Publications.

ENGINEERING DRAWING (Manual and Computer Aided)

1. GENERAL

1.1 COURSE TITLE: Engineering Drawing (Manual and Computer Aided)

1.2 *COURSE NUMBER: EP**.ME104.**14

1.3 CONTACT HRS: 1-0-3, Credits 6

1.4 *SEMESTER -OFFERED: Both

1.5 PREREQUISITE: None

1.6 SYLLABUS COMMITTEE MEMBERS: Dr. S. K. Shah (Convener), Dr. Amit Tyagi, Dr. D. Khan, Dr. U. S. Rao (ME)

2. OBJECTIVE

Technical drawing is the language of engineering. The objective of this course is to learn initially the basic principles involved in the projection of points, lines, lamina and solids. As well this course is focused towards the interpenetration of solids, development of surfaces, isometric drawings and some basics of computer aided drafting software. It is expected that a student should learn this subject in a very systematic way to develop the skill to express effectively his/her idea about an object to others through drawings.

3. COURSE CONTENT

UNIT I: 12 Contact Hours

Instruments used, Lettering, Types of Lines used, Types of Projections in use, Dimensioning of Figures, etc.; Orthographic Projections of Points, Lines & Lamina

UNIT II: 16 Contact Hours

Projection of Solids, Section of Solids & its Projections, Interpenetration of Solids & Curve of Interpenetration, Development of Surfaces.

UNIT III: 12 Contact Hours

Isometric Drawing & Isometric Projection, Free-Hand sketching of Engineering Components

UNIT IV: 12 Contact Hours

Introduction to Drafting Software (AutoCAD) & its Basic Commands, Solving Problems using AutoCAD.

4. READINGS

4.1 TEXT BOOKS

1. Title: Engineering Drawing Author: N. D. Bhatt
2. Title: Engineering Graphics With Autocad Author: James D. Bethune

4.2 REFERENCE BOOKS

1. Title: Engineering Drawing & Graphics Author: K. Venugopal
2. Title: Engineering Drawing Author R. K. Dhawan
3. Title: Engineering Drawing Author: M. B. Shah & B. C. Rana

5. OUTCOME OF THE COURSE

It is anticipated that after completion of the course, a student would be in a position to study/guide basic engineering drawings required in workshop for the fabrication purposes. Also this basic course will help the students to handle effectively the course on machine drawing.

UNIVERSAL HUMAN VALUES 1: Self and Family

1. GENERAL

1.1 COURSE TITLE: Universal Human Values 1: Self and Family

1.2 COURSE NUMBER: HU.**H101**.14

1.3 CONTACT HRS: 1-2-0, Credits 5

1.4 SEMESTER OFFERED: 1st

1.5 PRE-REQUISITES: 4-day Harmony–1 Workshop (co-requisite)

2. OBJECTIVE

The objective of the course is four fold:

1. Sensitization of student towards issues in all dimensions of life.
2. Inculcation of self reflection.
3. Understanding (clarity) of relationships, and family.
4. Exposure to issues in society and environment.
5. Development of commitment and courage to act.

2.1. Sensitization of student towards issues in all dimensions of life

There are a whole range of issues which one faces in life towards which the young students are generally unfamiliar and therefore insensitive. Almost all the concerns - environmental, societal, familial or personal, are result of human action. Sensitization towards them therefore is an important step.

2.2. Inculcation of Self Reflection.

Human action is governed by various internal factors primarily the beliefs one holds, and therefore _looking-in' becomes essential, to see what beliefs one is holding, whether they are really true or not, if they are not true, then what could be the process to get the "right" belief and then further validate it.

Most of the young people are somehow trained to look only ―outside‖. The motivation and the skill to look inside are missing. Inculcation of self reflection in students will result in them becoming more responsible, honest and trustworthy. Lack of such qualities in individuals is major concern of organizations, institutions and society in general.

2.3. Understanding (Clarity) of Human Relationships and Family.

It will try to show that relationships and material prosperity are the basic desire for a human being. Two global problems which we face today are war (including terrorism) and imbalance in nature (global warming). If we look at reasons for war, the fundamental cause is: Human Being is in opposition to other Human Being. Therefore one is willing (or gets compelled) to exploit others. This is due to lack of understanding of relationships.

2.4 Exposure to Issues in Society and nature (larger manmade systems and Nature)

- To show that the fundamental reasons for imbalance in nature are: pollution and resource depletion. Both these aspects are result of consumerist model of development.

- To show how harmony can be ensured at following levels of our living: individual, human-human relationships, larger society, Various social systems like education system, economic system, political system and others, and rest of the nature.

2.5. Development of Commitment and Courage to Act.

If the understanding is right, then the actions become right. Commitment and courage to act are considered consequences of right understanding in an individual. In the course, an attempt will be made to build right understanding in the individual, and then further plan of actions will also be discussed in order to implement the understanding in various life situations in the right manner.

3. COURSE TOPICS

Following are the topics to be covered in broadly the given sequence.

1. **Motivation and Objectives of Human Values Course:** Introduction to the objectives of the course. Content and process of the course including mode of conduct. Daily life as lab for the course. Activities in the course.
2. **Purpose of Education:** How human being has a need for Knowledge, what should be the content of knowledge, how the content should be discussed in education. Complimentarily of skills and values, how the current education system falls short.
3. **Peers Pressure, Social Pressure:** In various dimensions of life, how do these things work. What is the way out? In the context of education, peer pressure etc. movie "Taare Zameen Par" can be used.
4. **Concept of Competition and Excellence:** How competition leads to degradation of self and relationships. How excellence is the basic need of a human being. What is excellence? Movie "Fearless" can be used to discuss the concept.
5. **Time Management:** How does one deal with myriads of activities in college? Focus of the mind.
6. **Concept of Preconditioning:** How preconditioning affects our thinking, behavior, work, relationships, society and nature. How do we develop pre-conditioning? What are the various sources of preconditioning? How do we evaluate our Preconditioning? How do we come out of it?
7. **Concept of Natural Acceptance in Human Being:** What is natural acceptance? How can the concept of natural acceptance be used to evaluate our preconditioning. Universal nature of natural acceptance.

   Are anger, jealousy, hatred natural? How do we feel when we experience them?

   Which feelings are natural for a human being and which are not?
8. **Understanding Relationships.**

a) **Are relationships important?** What is the role of relationships in our life? If relationships are important then why they are important? If they are important then why it is the case that we are not discussing them? What are the notions/conditions and

factors which stop us to explore more into relationships. Relationships in family and extended family. Dealing with anger. Show film "Right Here, Right Now".

b) Basic expectations in relationships. Seven types of relations.

c) Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

d) Nine universal values in human relationships. Trust as the founding value.

e) Concept of acceptance. Unconditional acceptance in relationships.

f) Our preconditioning affecting our relationships.

Our relationships with subordinate staff, with people of opposite gender, caste, class, race. Movie "Dharm" (set in Varanasi) can be used to show the conflict between preconditioning and relationships. How relationships have the power to force a person to change his preconditioning.

9. **Concept of prosperity:** Material goods and knowledge of one's physical needs is essential for feeling of prosperity.
   What role others have played in making material goods available to me: Identifying from one's own life.
10. **Idea of Society.** What is a society? What constitutes a society? What systems are needed for a society to work? What is the purpose of society and various systems which are working in it?

How understanding of Human Nature is important in order to understand the purpose of Society and various social systems? And what happens when this understanding is lacking?

11. **Idea of decentralization of politics, economics, education, justice etc. Its comparison with centralized systems. The idea of Swaraj. Various social initiatives by NGOs, social organizations and other people.** (If time permits)
12. **Balance in nature**

a) **Balance which already exists in nature.**

b) **How human beings are disturbing the balance. Resource depletion and pollution.**

Our own role in wastage of electricity, water and in use of plastics. Waste management. (Show episode on city waste from Satyameva Jayate 2.)

c) **Issues like global warming, animal extinction.**

Show "Story of Stuff" documentary film. "Home" film can also be used.

4. READINGS

4.1 TEXT BOOK

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010.

4.2 REFERENCE BOOKS

1. The Story of Stuff (Book).
2. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
3. On Education - J Krishnamurthy

4. Siddhartha - Hermann Hesse
5. Old Path White Clouds - ThichNhatHanh
6. On Education - The Mother
7. Diaries of Anne Frank - Anne Frank
8. Life and Philosophy of Swami Vivekananda
9. Swami Vivekananda on Himself
10. Small is Beautiful - E. F Schumacher.
11. Slow is Beautiful - Cecile Andrews
12. JeevanVidya: EkParichaya, ANagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
13. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi
14. Rediscovering India - by Dharampal
15. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
16. India Wins Freedom - Maulana Abdul Kalam Azad
17. Ramakrishna kijeevani - Romain Rolland (English)
18. Vivekananda - Romain Rolland (English)
19. Gandhi - Romain Rolland (English)
20. Autobiography of a Yogi – by ParamhansaYogananda
21. Gandhi and Question of Science – Sahasrabudhe

5. OUTCOME OF THE COURSE

At the end of the course, students are expected to become more aware of their self and their relationships and would have better reflective and discerning ability. They would also become more sensitive to their surroundings including both people and nature, with commitment towards what they believe in (human values). It is hoped that they would be able to apply what they have learnt to their own self in different ordinary day-to-day settings in real life with higher commitment and courage.

BASIC ENGLISH

1. GENERAL

1.1 COURSE TITLE: Remedialenglish
1.2 *COURSE NUMBER: LM.**HL101.**14
1.3 CONTACT HRS: 2-0-1, Credit 7
1.4 SEMESTER-OFFERED: Ist Sem.

2. OBJECTIVE

To improve the language skill for the students who are not skilled enough to use English as a language for their academic needs.

3. COURSE TOPICS

1. Vocabulary Building

1.1. The concept of word formation
1.2. Root words from foreign languages and their use in English

1.3. Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives

1.4. Synonyms, antonyms and standard abbreviations

2. Basic Writing Skills

2.1. Sentence structures

2.2. Use of phrases and clauses in sentences

2.3. Importance of proper punctuation

2.4. Creating coherence

2.5. Organizing principles of paragraphs in documents

2.6. Techniques for writing precisely

3. Identifying Common Errors in writing

3.1. Subject-verb agreement

3.2. Noun-pronoun agreement

3.3. Misplaced modifiers

3.4. Articles

3.5. Prepositions

3.6. Redundancies

3.7. Clichés

4 Nature and style of sensible writing

4.1. Describing

4.2. Defining

4.3. Classifying

4.4. Providing examples or evidence

4.5. Writing introduction and conclusion

5 Writing practices

5.1. Comprehension

5.2. Précis writing

5.3. Essay writing

4. READINGS

1. Practical English Usage. Michael Swan. OUP. 1995.
2. Remedial English Grammar. F. T. Wood. Macmillan. 2007.
3. A course in Academic Writing. Renu Gupta. Orient Blackswan. 2010.
4. Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.

5. OUTCOME OF THE COURSE

To make students aware about the importance of a English for communication needs. Also to equip them for the higher courses such as Academic Writing and Professional Communication in later stages.

SEMESTER-II

CLASSICAL, QUANTUM & RELATIVISTIC MECHANICS

1. GENERAL

1.1 COURSE TITLE: Classical, Quantum & Relativistic Mechanics

1.2 *COURSE NUMBER: IS.**PHY101**.14

1.3 CONTACT HRS: 3-1-2, Credit 13

1.4 *SEMESTER -OFFERED: Both

1.5 PRE-REQUISITE: None

1.6 SYLLABUS COMMITTEE MEMBERS: Dr. P. C. Pandey (Convener), Prof. O. N. Singh, Prof. S. Chatterjee, Dr. (Mrs.) S. Upadhyay

2. OBJECTIVE

This course is prepared to understand the basic principles and laws of fundamental Physics for macroscopic, microscopic and system of particles. The 1st part of the course is devoted on the understanding of mechanics of a mechanical system in different coordinate system and reference frames. The second part of the syllabus is devoted on the concept of wave-particle duality and need of other formulation to explain the finding which could not be explained by known classical mechanics. The Schrodinger's equation and its application in different cases are also kept in the syllabus. As the mechanics of very fast moving object could not be explained by the above laws and principles, some understanding of special theory of relativity is also provided in the syllabus.

3. COURSE CONTENT

UNIT I: Classical Mechanics (15 Lectures)

Co-ordinate systems, plane polar, cylindrical and spherical polar co-ordinate systems, frame of reference, rotational frame, coriolis forces. Motion of system of particles, Conservation laws, Constraints and degrees of freedom, Generalized co-ordinates, Lagrange's and Hamilton's formulations, Poisson's brackets.

UNIT II: Quantum Mechanics (15 Lectures)

Origin of Quantum Mechanics, Plank's black body radiation, Matter waves and concept of wave function, Heisenberg uncertainty principle, Schrodinger's equation, Applications of Schrodinger time independent equation; (i) Particle in a box, (ii) Potential step, (iii) Potential barrier, (iv) Harmonic oscillator (one-dimensional) & (v) Periodic potential.

UNIT III: Relativistic Mechanics (8 Lectures)

Michelson – Morley experiment, postulates of special relativity, Lorentz transformation, length contraction, time dilation, Doppler effect, addition of velocities, variation of mass with velocity, equivalence of mass & energy, mass less particle.

4. READINGS

4.1 TEXTBOOK

1. D. Kleppner and R. J. Kolenkow, An Introduction to Mechanics, Tata McGraw-Hill,

2. D T Greenwood, Classical Dynamics, Prentice Hall of India, Pvt. Ltd., New Delhi
3. A. Beiser, Perspective of Modern Physics, McGraw-Hills Co., Inc., New York.
4. Robert Resnick. Introduction to special relativity

4.2 REFERENCE BOOKS

1. H Goldstein, Classical Mechanics, Reading Mass Adison-Wesley Press, Inc.
2. J L Powell and B Crasemann, Quantum Mechanics, Narosa Publishing House, New Delhi
3. Ghatak and Loknathan, Quantum Mechanics, Macmillan India Ltd.

5. OUTCOME OF THE COURSE

This course is designed in such a way that the students learn the fundamental Physics, which will construct the base for the study of Engineering and Technology.

ENGINEERING MATHEMATICS-II

1. GENERAL

1.1 COURSE TITLE: Engineering Mathematics - II
1.2 *COURSE NUMBER: IS.**MA102**.14
1.3 CONTACT HRS: 3-1-0, Credits 11
1.4 *SEMESTER -OFFERED: Both
1.5 PREREQUISITE: None
1.6 SYLLABUS OF COMMITTEE MEMBER: Prof. O.P. Singh (Convener), Prof. S.K. Pandey

2. COURSE CONTENT

UNIT 1: Vector spaces (5 Lectures)

Sets, Relations, equivalence relation, functions, partition of set, Cartesian product of Set, Binary operations, examples. Definition and examples ofGroups (stress on additive and multiplicative), Subgroups, Fields. Vector Spaces over real and complex fields. Subspaces. Some properties of subspaces. Finite linear combinations Dependent and independent vectors. Basis and Dimension of vector space. Basis and dimension (contd.), The infinite dimensional vector spaces $C^k[a, b]$, $L^p[a, b]$, $k = 0, 1, 2, \ldots$ and $p > 0$.

UNIT 2: Linear Transformations (7 Lectures)

Linear transformations, Kernel and Range of a linear transformation, nullity theorem., Matrix of a linear transformation over finite basis, Matrix of change of basis, Similar matrices, rank of a matrix. Solution of system of linear equations, Eigen values and eigen vectors, eigen space, Caley-Hamilton theorem and its implications. Inner product spaces, Matrix of inner product, norm induced by an inner product, parallelogram law.

UNIT 3: Orthogonal Expansion (5 Lectures)

Orthogonal and orthonormal vectors and systems, Gram Schmidt orthogonalization process. Orthogonal expansion of function in $L^2[a, b]$. Expansion of function in Fourier series (real and complex form), examples in $0,2\pi$, $-l,l$, $0,l$, Convergence and sum of Fourier series, Even and odd functions, half range expansions, Half range Fourier series , odd and even

extensions, Gibbs phenomenon, Trigonometric approximation, Parseval‘s relation, Bessel inequality, Fourier integrals, Fourier sine and cosine transforms.

UNIT 4: Holomorphic Functions (3 Lectures)

Planer sets, curves, domains and regions in the complex plane, continuous and differential functions of complex variables, Holomorphic functions, C-R equations, Laplace equation, Harmonic functions and their applications.

UNIT 5: Complex Integration (8 Lectures)

Line integral, bound for the absolute value of integrals, Cauchy integral theorem, Cauchy integral formula, Derivatives of holomorphic functions, Cauchy inequality, Liouville‘s theorem (with proof), morra‘s theorem (statement), fundamental theorem of algebra, Power series, radius of convergence and Taylor‘s series. Laurent Series, Laurent series (contd.), Singularities and Zeros, behavior of f(z) at infinity, Residues, Residue theorem, residue integration method, Evaluation of real integrals

UNIT 6: Differential Equations (10 Lectures)

Basic concepts and ideas of first order differential equations, geometrical meaning of y‘=f(x, y), direction fields, Exact differential equations, Integrating factors, Linear differential equations. Bernoulli equation, Existence and Uniqueness of solutions, Wronskian, Homogeneous linear equations of second order. Second-order Homogeneous equations with constant coefficients, Cases of complex roots, complex exponential functions Euler –Cauchy equation, Non homogeneous equations, Solution by undetermined coefficients, Solution by variation of parameters, System of differential equations: introductory examples-mixing problem involving two tanks, model of an electrical network, Conversion of an nth order differential equation to a system, linear systems.

3. TEXT BOOKS

1. Advanced Engineering Mathematics by Erwin Kreysgic.
2. Linear Algebra by K. Hoffman and Ray Kunz

ENGINEERING MECHANICS

1. GENERAL

1.1 COURSE TITLE: Engineering Mechanics

1.2 COURSE NUMBER: IE.**ME 102**.14

1.3 CONTACT HRS: 3-1-0, Credits 11

1.4 SEMESTER- OFFERED: Both

1.5 PREREQUISITE: None

1.5 SYLLABUS COMMITTEE MEMBER: Prof. S.K. Sinha (Convener), Dr. P. Bhardwaj, Dr. Amit Tyagi, Dr. N. Mallik (ME), Dr. Rajesh Kumar (CE)

2. OBJECTIVE

Engineering Mechanics adheres to a wide spectrum of Engineering Disciplines as a basic course at undergraduate level to understand the mechanics of statics and dynamics of a

system hitherto, the system/body assumed to be rigid with no deformation under the application of tractions and forces. Principles based on Newtonian Mechanics, Variational Mechanics, D'Alembert's Principle etc. are core to the preliminary analysis of systems in equilibrium. The impetus of the study shall be understanding the continuum mechanics model with applicability to almost all branches of engineering for an ab initio stability assessment of miniature to mega scale structural designs.

3. COURSE CONTENT

UNIT I: 6 Lectures

Introduction to position vector, force vector and moment vector, 3-D representation of force and couple; their moments about a point/line; Distributed-force systems

UNIT II: 8 Lectures

Free Body diagram; Equilibrium of a body under 2D/3D force systems

UNIT III: 6 Lectures

Dry friction; Self-locking; Belt friction;

UNIT IV: 6 Lectures

Truss; Virtual work Method; Potential Energy Method; Stability.

UNIT V: 5 Lectures

Centroid of plane areas; Moment of inertia of plane areas; Perpendicular-axis and parallel-axis theorems; Principal Axes

UNIT VI: 8 Lectures

Rectilinear and curvilinear motion of a particles; Work and energy; Impulse and momentum; General plane motion of a rigid body; Instantaneous axis of rotation; Central impact.

4. READINGS : :

4.1 TEXT BOOKS : :

1. Title: Engineering Mechanics Author: I. H. Shames
2. Title: Engineering Mechanics Author: R. C. Hibbeler

MODERN PHYSICS

1. GENERAL

1.1 COURSE TITLE: Modern Physics

1.2 *COURSE NUMBER: DC.**PHY 103**.14

1.3 CONTACT HRS: 2-1-0, Credit 8

1.4 SEMESTER-OFFERED: Even

1.5 PRE-REQUISITE: None

1.6 SYLLABUS COMMITTEE MEMBER: Prof. P. Singh (C), Prof. R. Prasad, Dr. S. K. Mishra

2. OBJECTIVE

The course aims to provide an introduction to the revolutionary developments in the field of Physics.

3. COURSE CONTENT

Michelson-Morley experiment & Special theory of relativity **(4 Lectures)**

Introduction to Quantum Physics, Atomic Structure, Hydrogen atom **(5 Lectures)**

Electromagnetic radiation in atomic transitions, Stimulated emission, coherence and laser **(2 Lectures)**

Nuclear structure, Nuclear reactions and transformation, fission, fusion, Radioactivity **(4 Lectures)**

Elementary particles and fundamental forces, Conservation laws **(3 Lectures)**

Crystalline and amorphous solids, band theory of solids, superconductivity **(4 Lectures)**

Quantum Statistics (Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics) **(3 Lectures)**

4. READINGS

1.1 TEXTBOOK

1. Feynman, R.P., "Feynman Lectures on Physics" Vol.1 and 3.
2. Krane, Kenneth S., "Modern Physics" (John Wiley & Sons, 1996)
3. Beiser, Arthur, "Concept of Modern Physics" Tata Mcgraw-Hill Edition.
4. Modern Physics by P.A. Tipler and R.A. Liewellyn, Publisher: W. H. Freeman; 5th edition.

4.2 *REFERENCE BOOKS

1. Modern Physics: for Scientist and Engineers by John Morrison, Publisher: Academic Press; 1st edition.
2. Modern Physics by Raymond A. Serway, Clement J. Moses and Curt A. Moyer, Publisher: David Harris, USA, Third Edition.

5. OUTCOME OF THE COURSE

Students will get basic concepts of different aspects of Modern Physics.

PRACTICES IN ENGINEERING PHYSICS

1. GENERAL

1.1 COURSE TITLE: Practices in Engineering Physics

1.2 *COURSE NUMBER: EP.**EP101**.14

1.3 CONTACT HRS: 1-0-3, Credit 6

1.4 SEMESTER-OFFERED: Even

1.5 PRE-REQUISITE: None

1.6 SYLLABUS COMMITTEE MEMBER: Dr. A. Mohan (Convener)

2. OBJECTIVE

Introduction to physical measurements, errors, uncertainties, their propagation in performing experiments and analysis of data.

3. COURSE CONTENT

1. **Error Analysis (2 Lectures)**
   Systematic errors, random errors, gross errors.
2. **Uncertainties in Measurements (3Lectures)**
   Internal and External estimates of uncertainties; propagation of uncertainties in compound quantities.
3. **Basic concept of data analysis (2 Lectures)**
   Dispersion, standard deviation.
4. Gaussian and Lorentzian distributions, chi-square test, curve-fitting. **(3 Lectures)**
5. Calibration; discussion related to the experiments. **(3 Lectures)**

4. READINGS

4.1 TEXTBOOK

1. Instrumentation, Measurement and analysis by B. C. Nakra and K. K. Chaudhary, Tata McGraw-Hill,
2. Fundamental of Statistics by S.C. Gupta, Himalaya Publishing House.

4.2 *REFERENCE BOOKS

5. OTHER SESSIONS

5.1 *LABORATORY

1. (a)To estimate the numerical aperture of a plastic fiber at 650 nm,(b) To measure the losses in a optical fiber communication link
   (i) propagation loss,(ii) bending loss, (iii) coupling loss.
2. Detection of Solar flares from Ionospheric disturbances using VLF waves.
3. To prepare coil magnet and to study the mutual inductance and hence to calculate the magnetization of a given sample.
4. Photoelectric effect in virtual lab.
5. To study the antenna characteristics in the microwave region.

6. OUTCOME OF THE COURSE

Students should be able to find out the error and their nature in performing experiments at basic and higher level, and also how to eliminate them.

PHILOSOPHY

1. **GENERAL**

1.1 COURSE TITLE: Philosophy

1.2 COURSE NUMBER: HU105

1.3 CONTACT HRS: 2-1-0, Credit 8

1.4 SEMESTER OFFERED: Both

1.5 PREREQUISITE: None

2. OBJECTIVE

Even though developments are taking place with greater production of physical facilities, conflict and strife are increasing in the individual and society. Environmental crisis in the form of climate change is putting life itself in danger.

In spite of achieving ones goals, the individual remains dissatisfied with jobs and positions that are intellectually and mentally unfulfilling, and wealth that breeds problems in family, chaos in society, and imbalance in nature. In fact, the nations and civilizations are increasingly at war.

It is believed that ideas in Humanities and Social Sciences can provide a new understanding, based on which one can move to overcome the current problems, both at the individual level as well as at the societal level.

This course is expected to relate philosophy to literature, culture, society and lived experience can be considered. This is in addition to training students in already available philosophical systems. Instead of only theory or only practical courses attempt can be made to combine both theory and practice.

This course is expected to bridge the gap between theory and practice by making the courses interactive. Along with projects, this course will have more illustrations that would invite students into the subject.

3. COURSE TOPICS

UNIT 1: The difference between knowledge (Vidya) and Ignorance (Avidya):

a. Upanishads;
b. Six systems orthodox and Heterodox Schools of Indian Philosophy.
c. Greek Philosophy:

UNIT 2: Origin of the Universe:

Nasidiya Sukta: "Who really knows?"

Brhadaranyaka Upanishad; *Chandogya Upanishad*: Non-self, Self, real and unreal.

Taittiriya Upanishad: Siksha Valli.

Plato‘s *Symposium*: Lack as the source of desire and knowledge.

Socratic method of knowledge as discovery.

Language: Word as root of knowledge (Bhartrahari‘s Vakyapadiyam)

Fourteen Knowledge basis as a sources of Vidya: Four Vedas; Six auxiliary sciences (Vedangas); Purana, Nyaya, Mimamsa and Dharma Sastras.

UNIT 3:

Knowledge as Power: Francis Bacon. Knowledge as both power and self-realization in Bagavad Gita.

UNIT 4:

Knowledge as oppression: M. Foucault. Discrimination between *Rtam* and *Satyam* in Indian Philosophy.

UNIT 5:

Knowledge as invention: Modern definition of creativity; scientific activity in the claim that science invents new things at least through technology.

UNIT 6:

Knowledge about the self, transcendental self; knowledge about society, polity and nature.

UNIT 7:

Knowledge about moral and ethics codes.

UNIT 8:

Tools of acquiring knowledge: *Tantrayuktis*, an system of inquiry (Caraka, Sushruta, Kautilya, Vyasa)

4. READINGS

1. Copleston, Frederick, *History of Philosophy, Vol. 1*.Great Britain: Continuum.
2. Hiriyanna, M. *Outlines of Indian Philosophy*, Motilal Banarsidass Publishers; Fifth Reprint edition (2009)
3. Sathaye, Avinash, *Translation of Nasadiya Sukta*
4. Ralph T. H. Griffith. *The Hymns of the Ṛgveda*. Motilal Banarsidass: Delhi: 1973.
5. Raju, P. T. *Structural Depths ofIndian Thought*, Albany: State University of New York Press.
6. Plato, *Symposium*, Hamilton Press.
7. Kautilya *Artha Sastra*. Penguin Books, New Delhi.
8. Bacon, *Nova Orgum*
9. Arnold, Edwin. *The Song Celestial*.
10. Foucault, *Knowledge/Power.*
11. Wildon, Anthony, *System of Structure*.
12. Lele, W.K. *The Doctrine of Tantrayukti.* Varanasi: Chowkamba Series.
13. Dasgupta, S. N. *History of Indian Philosophy*, Motilal Banasidas, Delhi.
14. Passmore, John, *Hundred Years of Philosophy*, Penguin.

5. ASSESSMENT (indicative only)

Ask students to do term papers, for example, writing biographical details of founders, sustainers, transmitters, modifiers, rewriters; translating monographs of less known philosophers such as K. C. Bhattacharys, Daya Krishna, Gopinath Bhattacharya; comparative study of philosophical system such as Madhyastha Darshan.

6. OUTCOME OF THE COURSE

Students will develop strong natural familiarity with humanities along with right understanding enabling them to eliminate conflict and strife in the individual and society. Students shall be able to relate philosophy to literature, culture, society and lived experience can be considered.

EDUCATION AND SELF

1. GENERAL

1.1 COURSE TITLE: Education and Self

1.2 *COURSE NUMBER: IH.**H106**.14

1.3 CONTACT HRS: 2-1-0, Credit 8

1.4 SEMESTER-OFFERED: Both Semester

1.5 PRE-REQUISITES: None

2. OBJECTIVE

In this course it is emphasized that understanding self is a crucial aspect of education, and this course aims to explicitly highlight concern for relationship between education and society. Assumption is that any concern with the social issues without understanding the self is likely to cause complications that we witness amongst the well meaning activists today. An understanding of one‘s psycho-physical makeup, underlying motivations and aspirations helps not only an understanding of oneself but also creates an understanding of social interactions. On the other hand, sole occupation with self is likely to alienate the social aspects. Thus it is considered necessary to view concerns of education in relation to social environment as well.

Education or ‘shiksha’ is not so much a matter of pedagogy as of a ‘way of life’. The fabric of interpersonal relations, values, aspirations, language and many other factors mould the nature of knowledge, learning and teaching.

3. COURSE TOPICS

Following are the topics to be covered in broadly the given sequence.

UNIT I: Understanding Education.

1. Dialogues on education.
   - To reflect over meaning and significance of education.
2. History and philosophy of education.
   - Search for truth and understanding of cosmos and society.
   - Pre industrialization and post industrialization.
3. Modern education, a process of alienation from self and society.
   - Critique of education from the Western and Indian perspectives

UNIT II: Indian Perspectives of Education.

1. Notions of Vidya, Shiksha, Talim and Education.
2. Upanishads and Raj-Yoga for understanding and educating the Self.
   - Spirit of enquiry of the Upanishads and the path of Ashtanga Yoga.
3. Role of education in transforming social consciousness.
   - Alternatives in education in 19th-20th century India.

UNIT - III: Present efforts to integrate education, self, and society.

1. Drawing upon traditions of Gurukuls, Monanstries, and Yogic practices.
2. Shiksha and Samaj

- The process of learning and teaching as an integral part of a society.
- Shiksha/education in relation to socio-environmental concerns.

4. READINGS

1. Education and the Significance of Life. J. Krishnamurti, Gollancz, London,1955.
2. Glimpses of Raja Yoga, Vimala Thakar, Vimal Prakashan Trust, Ahmedabad,India,!998.
3. Hind Swaraj or Indian Home Rule, Mohandas K. Gandhi. Navjeevan Trust, Ahmedabad,India 1938 (Complete book online.)
4. Kathopanishad: An alchemy of life, Vimala Thakar. Vimal Prakashan Trust, Panchgani, Maharashtra. 2006.
5. Shiksha Evam Parampara, Part I, Samdhong Rinpoche, Bir Conference on Indian Perspectives of Education. Audio- Video Recording, SIDH, Mussoorie. Uttranchal, India.
6. Shiksha Evam Parampara, Part II, Samdhong Rinpoche, Panchgani Seminar on Indian Perspectives of Education. Audio- Video recording, Vidyadan Foundation for Education, Panchgani, India.
7. Patanjala Yoga Sutras, P.V Karambelkar, Kaivalyadham, Lonavala, Maharashtra, India
8. Communal Life in India, Rabindranath Tagore, The Modern Review for June 1913
9. The Beautiful Tree, Dhrampal. Collected Writings Vol III, Other India Press, SIDH, Mussoorie, Uttranchal, India, 2007.
10. The Complete Works of Swami Vivekananda, Eleventh Edition,Vols 4,6,8, Advait Ashram, Mayavati, Pithoragarh, Himalayas.
11. Vidya evam samaj, Ravindra Shrama. Panchgani Seminar, Indian Perspectives of Education, Audio-Video recordings, September 2012
12. Yoga beyond Meditation, Vimala thakar. VImal Prakashan Trust, Ahmedabad,India.

Websites

1. History of Education. https://www.Wikipedia, the free encyclopedia.
2. The people‘s institute for Rethinking Education. https://www.swaraj.org/shikshantar
3. Finding Purpose in Education. https://www.Sidh.
4. Indian Perspectives of Education. https://www.Vidyadan.com.

5. ASSESSMENT (indicative only)

Projects and Term Papers might be there. One possible mode of project is as follows.

a. Projects: Along with the faculty, the students will interview thinkers, educationists, and activists to connect with topics of the above stated three units. The reports would be analyzed and presented by the students.

6. OUTCOME OF THE COURSE

As noted in the course objective/description, the mainstream education tends to alienate us from ourselves and the society. With the help of the above mentioned topics and interactions,

we expect the students to become aware of the limitations of our existing education system and become part of exploring alternatives.

ELEMENTARY PHYSICAL EDUCATION

1. GENERAL

1.1 COURSE TITLE: Elementary Physical Education
1.2 *COURSE NUMBER: GY.**PE101**.14
1.3 CONTACT HRS: 0-1-3**,** Credit 5
1.4 SEMESTER-OFFERED: Both
1.5 PRE-REQUISITES: None
1.6 SYLLABUS COMMITTEE MEMBER: Dr. Satish Kanaujiya

2. OBJECTIVE

All round development of Personality (physical, mental, social & Spiritual development) of students through Physical Activities**.**

3. COURSE CONTENT

UNIT I: Physical Fitness

Definition and benefits of Physical Fitness, Components of Physical Fitness, Types of Physical Fitness (Health related & Performance related)

UNIT II: Warming up and Cooling Down

Warming up and its significance. Types of warming up. Cooling Down

UNIT III: Practical in Sports Field

Basic Physical Exercises.Basic Skills of Selected Games

4. READINGS

1. Bucher C.A., Foundation of Physical Education. St. Louis: The C.V. Mosby Co., 1972.
2. Sharman, J.R. Introduction to Physical Education, New York, A. S. Barnes & Co. 1964.
3. Marley, William P., Health and Physical Fitness. Taking Charge of your Health. CBS College Publishing. Philadelphia, 1982.
4. Fox, Edward L. and Mathews, Donald K., The Physiological Basis of Physical
5. Education and Athletics. Saunders College Publishing, New York, 3rd Edition, 1981.

5. ASSESSMENT

Continuous assessment through class test and performance in the playground.

6. OUTCOME OF THE COURSE

To make students aware about the importance of Physical Activities and sports in their daily life. Also, to equip them with the knowledge of healthy living and better life.

SEMESTER-III

ENGINEERING THERMODYNAMICS
(For 2014-15 batches only)

1. GENERAL
1.1 COURSE TITLE: Engineering Thermodynamics
1.2 *COURSE NUMBER: IE.**ME103**.14
1.3 CONTACT HRS: 3-1-0, Credits 11
1.4 *SEMESTER -OFFERED: Both
1.5 PREREQUISITE: None
1.6 SYLLABUS COMMITTEE MEMBER: Prof. P. Ahuja (CH) (Convener), Prof. S.P. Singh (CR), Prof. B.N. Sharma (MT), Prof. M. Prasad (ME), Dr. S.S. Mondal, Dr. J. Sirkar, Dr. B. Eshpuniyani

2. OBJECTIVE
The course shall prepare the students to understand the laws of thermodynamics and apply them to various engineering problems and also to understand the thermodynamic property relations and their usage in thermodynamic property estimation.

3. COURSE CONTENT
UNIT I: Introduction. **(2 Lectures)**
Concept of internal energy, enthalpy, heat and work. State and path functions. Degrees of freedom for saturated and superheated steam and subcooled liquid. Extensive and intensive properties. Work done in an internally reversible non-flow process.T-V, P-V, and P-T diagrams of a pure substance. Standard Molar heat capacity (of pure ideal gas, pure liquid and pure solid) as a function of temperature. Zeroth law of thermodynamics.

UNIT II: Importance of equations of state. **(2 Lectures)**
Ideal gas equation of state. vander Waals fluid equation of state. Reduced temperature and reduced pressure. Two-parameter and three-parameter Law of corresponding states. Molar volume of saturated vapour and saturated liquid. Compressibility factor of gases and liquids.

UNIT III: First law and its applications. (6 Lectures)
Non-flow processes: Energy balance in a non-flow process. Constant pressure process, constant volume process, constant temperature process, adiabatic process, poly tropic process Steady Flow processes: Energy balance in a steady flow process. Work done in an steady flow process. Nozzles and diffusers, turbines and compressors, multistage compression with intercoolers. Transient flow processes, uniform flow process, charging process, discharging process.

UNIT IV: Second law and its applications (6 Lectures)
Carnot cycle. Clausiusinequality, Limitations of first law, Entropy balance for closed system, Reversible and irreversible expansion at constant temperature, Irreversibility due to heat transfer over temperature difference. Increase of entropy principle. Entropy balance for

control volume. Adiabatic efficiency of steady flow devices. Statistical interpretation of entropy. Third law of thermodynamics.

UNIT V: Exergy (or Availability) (4 Lectures)

Exergy of heat. First and second law efficiency of a heat engine. Reversible useful work of non-flow processes, Exergy of non-flow process. PdV versus reversible work for non-flow process. Irreversibility of non-flow process. Lost work. Reversible work of steady flow process. Comparison of Internally reversible, reversible and irreversible processes.

UNIT VI: Chemical reactions (3 Lectures)

Standard enthalpy, entropy and Gibbs energy of formation at 298.15 K. Standard enthalpy change of reaction as a function of temperature. Standard entropy change of reaction as a function of temperature. Standard Gibbs energy change of reaction as a function of temperature.

UNIT VII: Thermodynamic property relations of pure substances (8 Lectures)

Introduction to the thermodynamic properties of idealized and real fluids. Thermodynamic Relations for dU, dH, dA, and dG. Maxwellrelations. General equation for dU, dH, dS. Volumeexpansivity and isothermal compressibility. General equation for molar heat capacities. Joule-Thomson coefficient. Clapeyron equation. Antoine equation. Residual property. dU, dH, and dS for ideal gases and real gases. Calculations of Joule-Thompson coefficient and residual properties of gases and liquids and molar heat capacity at constant pressure using van der Waals equation of state. dG=RT dlnf, and the importance of fugacity in relation to equilibrium.

UNIT VIII: Thermodynamic cycles. (7 Lectures)

Rankine cycle. Comparison of Carnot and Rankine cycles. Reheat cycle. Regenerative cycle. Air standard power cycles. Otto cycle. Diesel cycle. Brayton cycle. Coefficient of Performance. Reversed Carnot Cycle. Vapour-compression refrigeration cycle. Ammonia absorption refrigeration cycle. Linde-Hampson liquefaction cycle.

4. READINGS

4.1 TEXTBOOK

1. Nag, P.K., Engineering Thermodynamics, Third Edition, Tata McGraw-Hill, New Delhi, 2005.

4.2 *REFERENCE BOOKS

1. Cengel, Y.A. and Boles, M.A., Thermodynamics: An Engineering Approach, McGraw-Hill, New York, 1988
2. Howell, J.R. and Buckius, R.O., Fundamentals of Engineering Thermodynamics, McGraw-Hill, Singapore, 1987
3. Huang, F.F., Engineering Thermodynamics: Fundamentals and Applications, Macmillan Publishing Co., 1976.
4. Jones, J.B. and Hawkins, G.A., Engineering Thermodynamics, Prentice Hall of India, 2000.

5. Moran, M.J. and Shapiro, H.N., Fundamentals of Engineering Thermodynamics, Fourth Edition, John Wiley, 2000
6. Rogers, G. F. C. and Mayhew, Y. R., Engineering Thermodynamics, Work and Heat Transfer, Fourth Edition, Pearson Education, New Delhi, 1992
7. Van Wylen, G.J. and Sonntag, R.E., Fundamentals of Classical Thermodynamics, Third Edition, John Wiley, New York, 1985
8. Wark, K., Thermodynamics, Fourth Edition, McGraw-Hill, New York, 1983
9. Ahuja, P., Chemical Engineering Thermodynamics, PHI Learning, 2009

5. OUTCOME OF THE COURSE

The students have learnt to apply first and second laws of thermodynamics to various engineering problems and also learnt the usage of thermodynamic property relations for estimation of thermodynamic properties using steam tables and equations of state.

FLUID MECHANICS

1. GENERAL

1.1 TITLE: Fluid Mechanics
1.2 *COURSE NUMBER::IE**.CHO 102.**14
1.3 CREDITS:: 3-1-0 – Credits 11
1.4 *SEMESTER -OFFERED:: Odd
1.5 Prerequisite: None
1.5 Syllabus Committee Member: Dr. R.S. Singh (Convener), Sri A. C. Mohan (CH), Dr. P. Shukla, Dr. S.S. Mondal, Dr. A. Sirkar (ME)

2. OBJECTIVE

This is a core subject, basic knowledge of which is required by all the engineers in general and civil, mechanical and chemical engineers in particular. This course aims at developing an understanding of the behaviour of fluids in motion or at rest and the subsequent effects of the fluids on the boundaries. The study of this subject will develop analytical abilities related to fluid flow.

3. COURSE CONTANT

UNIT I: (5 Lectures)

Fluid Properties and Fluid Statics: Concept of fluid and flow, ideal and real fluids, continuum concept, properties of fluids, Newtonian and non-Newtonian fluids. Pascal‘s law, hydrostatic equation, hydrostatic forces on plane and curved surfaces, stability of floating and submerged bodies, relative equilibrium.

UNIT II: (6 Lectures)

Fluid Kinematics: Eulerian and Lagrangian description of fluid flow; stream, streak and path lines; types of flows, flow rate and continuity equation, differential equation of continuity in cylindrical and polar coordinates, rotation, vorticity and circulation, potential flow, stream and potential functions, flow net.

UNIT III: (6 Lectures)
Fluid Dynamics: Concept of system and control volume, Euler‘s equation, Bernoulli‘s equation, kinetic and momentum correction factors, Impulse momentum relationship and its applications.
UNIT IV:(4 Lectures)
Dimensional Analysis and Hydraulic Similitude: Dimensional analysis, Buckingham‘s Pi theorem, important dimensionless numbers and their significance, geometric, kinematics and dynamic similarity, model studies.
UNIT V: (4 Lectures)
Viscous Flow: Flow regimes and Reynold‘s number, Relationship between shear stress and pressure gradient, uni-directional flow between stationary and moving parallel plates.
UNIT VI: (6 Lectures)
Flow Through Pipes: Major and minor losses in pipes, Hagen-Poiseuilli law, hydraulic gradient and total energy lines, series and parallel connection of pipes, branched pipes; equivalent pipe, power transmission through pipes, pipe fittings and valves.
UNIT VII: (6 Lectures)
Boundary Layer Flow: Boundary layer concept, displacement, momentum and energy thickness, laminar and turbulent boundary layer flows, Drag force and drag coefficient ,drag on a flat plate, boundary layer separation and control. Streamlined and bluff bodies, lift and drag on a cylinder and an airfoil.
UNIT VIII: (5 Lectures)
Turbulent Flow: Shear stress in turbulent flow, Prandtl mixing length hypothesis, hydraulically smooth and rough pipes, velocity distribution in pipes, friction coefficients for smooth and rough pipes.
UNIT IX: (5 Lectures)
Flow Measurement: Manometers, pitot tubes, venturi meter and orifice meters, orifice, mouthpieces, Open channel flow, notches and weirs, rotameter, mass flow meter and hot-wire anemometer.
UNIT X: (5 Lectures)
Working principles, characteristics, selection and power requirements in mixing of fluids, pumps, blowers and compressors.

4. READINGS

4.1 TEXTBOOK::

1. Introduction to Fluid Mechanics, Fox &Mcdonald, John & Wiley
2. McCabe, W.L., Smith J.C., and Harriot, P., ―Unit Operations in Chemical Engineering‖, McGraw-Hill, Inc.
3. Fluid Mechanics – Streeter V L and Wylie E B, Mc Graw Hill
4. Coulson, J.M. and Richardson, J.F., ―Chemical Engineering, Volume I‖, Pergamon Press.
5. Fluid Mechanics Frank M. White 7th edition Mcgraw-Hill

4.2 *REFERENCE BOOKS::

1. Geankoplis, C.J., ―Transport Processes and Unit Operations‖, Prentice-Hall Inc.

2. Introduction to Fluid Mechanics and Fluid Machines – S.K. Som and G. Biswas, TMH

5. OUTCOME OF THE COURSE

1. Conceptual understanding of fluids and their properties.
2. Understanding of fluid statistics, fluid kinematics and fluid dynamics.
3. Basic knowledge of dimensional analysis and similitude.
4. Understanding of laminar and turbulent flows, and flow measurement.

FUNDAMENTALS OF ELECTRICAL ENGINEERING

1. GENERAL

1.1 COURSE TITLE: Fundamentals of Electrical Engineering

1.2 *COURSE NUMBER: IE**.EO101.**14

1.3 CONTACT HRS: 3-1-2, Credits 13

1.4 *SEMESTER-OFFERED: Both

1.5 PREREQUISITE: None

1.6 SYLLABUS COMMITTEE MEMBER: Prof. R.K. Pandey (Convener), Prof. R.K. Mishra, Dr. S.K. Singh, Ms. Sobhota Mehar

2. OBJECTIVE

To provide a fundamental background to all Engineering students with minimum knowledge of Electrical Engineering so as to cope up with day to day industrial problems.

3. COURSE CONTANT

UNIT I: Concepts of Electrical Circuits (15 Lectures)

Basics of work, energy and power relations, DC/AC series and parallel circuits-KVL, voltage divider rule, current divider rule, power divider rule, practical voltage sources, voltage regulation, maximum power transfer theorem, KCL, voltage sources in parallel, Duality between series and parallel circuits, Network theorems- Thevenin‘s theorem, Norton‘s theorem, Superposition theorem, Millman‘s theorem, Reciprocity theorems, Mesh analysis, Nodal analysis, DELTA-WYE and WYE-DELTA Transformations, Transient circuit analysis-RC, RL, RLC, Series and Parallel magnetic circuit calculations, concepts of self inductance, mutual inductance and coefficient of coupling, DOT convention, Phasor quantities in time domain, Variation of inductive and capacitive reactance with frequency, Active, apparent power and power factor, Concepts of resonance in electrical circuits and applications, Three-phase circuits- line and phase relationship, power measurement.

UNIT II: Basics of Electrical Machines (15 Lectures)

Transformer – principle of working, EMF equation, equivalent circuit, voltage regulation and efficiency, open circuit and short-circuit tests, autotransformer. DC machines basics, DC Generators- no load magnetization and external characteristics. D C motors – starting, speed-torque characteristics, speed control, Induction machines – principle of operation, torque-slip characteristics, starting and speed control, Synchronous Machines- Alternators and voltage regulation.

UNIT III: Basics of Electrical Power Transmission & Distribution (10 Lectures)

Lay out diagram of substation and associated equipments for 765kv/400kv/220kv/132kv/33kv/11kv. Identification of problems related to voltage fluctuations in distribution systems- house, commercial complex, industries, Knowledge of phase balancing in distribution system- practical approach, Methodology of Tariff determination for various consumers such as domestic, commercial and industrial, Electrical wiring of houses-practical approach.

UNIT IV: Electrical Measurements Fundamentals (5 Lectures)

Basic constructional features of Indicating instruments- voltmeter, ammeter, wattmeter and energy meter along with usage in circuit.

4. READINGS

4.1 TEXTBOOK

2. Circuit Analysis- Irving L. Kosow
3. Electric Machinery- A. E. Fitzgerald, Charles Kingsley, Jr. and Stephen D. Umans
4. Transmission and Distribution of Electrical Power-J. B. Gupta
5. Electrical Measurements- A. K. Sahney

4.2 *REFERENCE BOOKS: NIL

5. OTHER SESSION

5.1 *TUTORIALS: 25

5.2 *LABORATORY: 10

5.3 *PROJECT: NIL

QUANTUM PHYSICS

1. GENERAL

1.1 COURSE TITLE: Quantum Physics

1.2 *COURSE NUMBER: MC.**PHY201**.15

1.3 CONTACT HRS: 3-1-0, Credit 11

1.4 SEMESTER-OFFERED: Odd

1.5 PRE-REQUISITE: PHY-101: Classical, Quantum and Relativistic Mechanics

1.6 SYLLABUS COMMITTEE MEMBER: Dr. S. Upadhyay (Convener), Dr. S. K. Mishra, Prof. D. Giri

2. OBJECTIVE

To introduce the formal structure of Quantum Mechanics and few applications of Quantum Mechanics.

3. COURSE CONTENT

Review of wave mechanics: A brief review of foundations of Quantum Mechanics, Wave-Particle duality, Heisenberg uncertainty principle, Wave function, Postulates of Quantum Mechanics, Schrodinger's Equation in one dimension. **(4 Lectures)**

Review of linear algebra: A brief overview of vector spaces matrices and vectors, eigenvalues and eigenvectors of matrices. **(6 Lectures)**

Operator method in Quantum mechanics: Hermitian Matrices, Linear operators, Dirac notation, Eigenvalue problem, Commutator Algebra, Functions of operators, Harmonic oscillator, Angular Momentum, Addition of angular momenta. **(10 Lectures)**

Schrodinger's Equation in three dimensions: Particle in a box problem in Cartesian and spherical polar coordinates, spherically symmetric potential, Hydrogen atom. **(5 Lectures)**

Identical Particles and Pauli Exclusion Principle. **(3 Lectures)**
Time Dependence in QM: Schrodinger, Heisenberg and Interaction Pictures. **(2 Lectures)**
Approximation methods in Quantum Mechanics: Variational method, Time independent perturbation theory and Time dependent perturbation theory. **(9 Lectures)**

4. READINGS

4.1 TEXTBOOK

1. Quantum Physics by S. Gasiorowicz, Publisher: Wiley; 3rd ed.

4.2 *REFERENCE BOOKS

1. Introduction to Quantum Mechanics by D J Griffiths, Publisher: Addison Wesley; 2 edition
2. Quantum Mechanics by C. Cohen-Tannoudji, Bernard Diu and F. Laloe, Publisher: Wiley-VCH;
3. Principles of Quantum Mechanics by R. Shankar, Publisher: Plenum Press; 2nd edition

5. OUTCOME OF THE COURSE

After completing this course the students are expected to have a fair knowledge of quantum states, operators and quantum measurements. Students will have a good practice for solving various problems in quantum mechanics and application of approximation methods. This course will set a basis for Atomic Physics, Condensed Matter, Statistical Mechanics courses. The course will also be helpful in realizing vector spaces and in shedding light on the usefulness of linear algebra for physical problems.

SEMICONDUCTOR PHYSICS AND DEVICES
(For 2014-15 batches only)

1. GENERAL

1.1 COURSE TITLE: Semiconductor Physics and Devices
1.2 *COURSE NUMBER: DC.**EO207**.15
1.3 CONTACT HRS: 2-1-2, Credit 10
1.4 SEMESTER-OFFERED: Odd
1.5 PRE-REQUISITE: None
1.6 SYLLABUS COMMITTEE MEMBER: Dr. A. Mohan (Convener), Dr. A. K. Srivastava

2. OBJECTIVE

This is an introductory course at the undergraduate level in semiconductor physics and devices. The course aims at the fundamental understanding of the semiconductors and the principles of a number of common electronic devices. It describes the electronic band structures, band gaps, Fermi level, etc. From this course, the students will know how this fundamental course is applied to the technologically important semiconductor materials, which leads to today's information revolution. The application part will be understood by doing experiments in the corresponding Physics lab.

3. COURSE CONTENT

Semiconductors: Bonds in Semiconductors, band theory, Concept of Fermi level and carrier concentration in Semiconductors, Intrinsic & extrinsic semiconductor, Majority and minority carriers, effect of temperature on conductivity of Semiconductors. p-n diode, drift current, diffusion current, V-I characteristics of p-n junction, Half wave and Full wave rectifier. Efficiency of half wave and full wave rectifiers, Ripple factor, Filter Circuits, Zener diode: Voltage stabilization**. (10 Lectures)**

Transistors: Transistors connections in common base, common emitter, and common collector configurations and their characteristics. Transistor amplifier: Transistor load line analysis, Operating point, Hybrid parameters, transistor amplifiers in CE and CB arrangement**. (7 Lectures)**

Uni Junction Transistor: I-V characteristics and use as Relaxation oscillator, FET Silicon Controlled Rectifier: I-V characteristics and use as phase controlled rectifier. **(6 Lectures)**

Feedback principle: Characteristics of negative feedback amplifiers, Positive feedback and oscillators. (**3 Lectures)**

4. READINGS

4.1 TEXTBOOK

1. Fundamentals of Semiconductor Devices by Joseph Lindmayer, Charles Y. Wrigly, D. Van Nostrand Company (1966).
2. Physics of Semiconductor Devices by S.M.Sze, John Wily & Sons, New Delhi, 1985.
3. Semiconductor Electronics by A.K. Sharma, New Age International (P) Limited Publisher, New Delhi, 1996.
4. Electronics: Fundamentals and Applications by Rakshit and Chattopadhyay, New Age International Publishers Ltd, New Delhi,2010.

4.2 *REFERENCE BOOKS

1. Electronics Devices and Circuits by Millman & Christos C. Halkias Electronic Devices & Circuits McGraw-Hill 1967

5. OTHER SESSIONS

5.2 *LABORATORY

1. Study of V-I characteristics of junction diode (Si & Ge) under forward and reverse conditions.
2. Demonstration of the use of diode as half wave and full wave rectifier.
3. Study the V-I characteristics of a Zener diode and demonstrate its use as a voltage regulator.
4. Study the input and output characteristics of BJT in CE configuration.
5. Study the input and output characteristics of BJT in CB configuration.

6. OUTCOME OF THE COURSE

To apply the fundamental knowledge from Solid State Physics to the technologically important and useful materials. To comprehensively understand the physics of semiconductors. To understand the physical basis and the use of typical semiconductor devices.

SOLID STATE ELECTRONIC DEVICES
(For 2016 batches onwards)

1. GENERAL

1.1 COURSE TITLE: Solid State Electronic Devices

1.2 *COURSE NUMBER: DC.**EC201**.15

1.3 CONTACT HRS: 3-0-3, Credit 12

1.4 SEMESTER-OFFERED: Odd

1.5 PREREQUISITE: None

1.6 SYLLABUS COMMITTEE MEMBER: Prof. V.N. Mishra (Convener)

2. OBJECTIVE

To introduce the basic concepts and impart practical knowledge of the solid state electronic devices.

3. COURSE CONTENT

Semiconductors: Energy band diagram, bulk properties conduction mechanism, metal semiconductor contact.

Junction Diodes: Current-Voltage characteristics, low frequency model, transient response and breakdown mechanism.

Bipolar Junction Transistors (BJT's): Device structure and physical operation, current-voltage characteristics, transient transistor biasing and thermal stabilization, low and high frequency models.

Unijunction Transistor (UJT): Device structure, current-voltage characteristics, applications.

JFET, MOS, Field-effect transistor (MOSFET): Device structure, (EMD, DMD) and physical operation, Gradual channel approximation, current-voltage characteristics, MOS biasing, Small-signal operation and models. MOSFET internal capacitances and high frequency model.

Laboratory Experiments (3 hours/week):

1. Junction diode I-V characteristics.
2. Design of half-wave and full wave rectifier.
3. Design of voltage regulator using zener diode.
4. Input and output characteristics of bipolar junction transistor in common base and common emitter configuration.
5. Study of current voltage characteristics of a unijunction transistor, Relaxation oscillator using UJT.

6. JFET volt ampere characteristics.

4. READINGS

4.1 TEXTBOOK

4.2 *REFERENCE BOOKS

5. OUTCOME OF THE COURSE

FIBER OPTICS

1. GENERAL

1.1 COURSE TITLE: Fiber Optics

1.2 *COURSE NUMBER: DC.**EO237**.15

1.3 CONTACT HRS: 3-0-0, Credit 9

1.4 SEMESTER-OFFERED: Odd

1.5 PREREQUISITE: None

1.6 SYLLABUS COMMITTEE MEMBER: Dr. P. C. Pandey (Convener), Prof. O. N. Singh

2. OBJECTIVE

Fiber optics has emerged to a level where it plays key role in almost all of the relevant engineering fields. This course covers the fundamentals of fiber optics including the aspects of planar waveguide, modal analysis of fibers and wave propagation characteristics of such fibers. This also contains the details about attenuation in optical fiber, fiber materials and techniques involved in fiber fabrication.

3. COURSE CONTENT

Introduction: Advantages, recent developments and applications of fiber optics. Ray propagation in an optical fiber, meridional rays, skew rays, Fiber numerical aperture. Over view of optical fiber communications, the evolution of fiber optic systems, elements of optical fiber transmission links. **(6 Lectures)**

Electromagnetic analysis of planar waveguide: Classification of modes for a planar waveguide, TE and TM modes in a symmetric step index planar waveguide, power associated with a mode, excitation of guided modes. **(Lectures)**

Modal analysis of Step-index and Graded-index fibers: Wave equation and boundary conditions, Characteristic equations, Hybrid modes, Weakly guiding approximation, linearly polarized modes, V parameter, Single mode fiber, Mode field diameter, power confinement and mode cutoff, Profiles for graded index fiber, Modal analysis of graded index fiber, Optimum profile. **(10 Lectures)**

Attenuation, materials and fabrication: Absorption loss, scattering loss, bending loss, splice loss, transverse, angular and Longitudinal misalignment losses. Fiber materials, Fiber fabrication and characterization, splices, connectors and fiber cable. **(9 Lectures)**

Pulse propagation and dispersion in optical fibers: Pulse propagation in non-dispersive and dispersive medium, Pulse broadening and chirping, Group and phase velocity, Intermodal

and intramodal dispersion, material and waveguide dispersion, fiber bandwidth. Dispersion shifted and dispersion flattened Fiber. **(9 Lectures)**

4. READINGS

4.2 TEXTBOOK

1. K. Ghatak & K. Thyagarajan, Introduction to Fiber Optics, Cambridge University Press (1998).
2. J. M. Senior, Optical Fiber Communication, Prentice Hall (1999).
3. G. Keiser, Optical Fiber Communications, McGraw Hill (2000).

4.2 *REFERENCE BOOKS

1. K. Okamoto, Fundamentals of Optical Waveguides, Academic Press, (2000).
2. D.K. Mynbaev and LL Scheiner, Fiber-Optic Communications Technology, Pearson
3. John A. Buck, Fundamentals of Optical Fibers, Wiley Interscience, (2004).

5. OUTCOME OF THE COURSE

After completing this course the students will be able to understand the fundamentals of optical fiber in terms of structure, wave guiding and fabrication. Students will also be able to calculate losses and dispersion due to different ways.

DEVELOPMENT OF SOCIETIES

1. GENERAL

1.1 COURSE TITLE: Development of Societies

1.2 *COURSE NUMBER: IH.**H103**.14

1.3 CONTACT HRS: 2-1-0, Credits 8

1.4 SEMESTER-OFFERED: Both

1.5 PRE-REQUISITES: None

2. OBJECTIVE

This is one of the foundation courses of Humanities (in Foundation Area 1). It is envisaged that this course will provide a natural link between engineering and humanities with an emphasis that Development is not just materialistic, larger view of all round human development should also be considered. Importance of sustainable development, inter-dependence and co-existence in nature should be realised through this course. It is to gain an understanding of alternative models of development.

3. COURSE CONTENT

UNIT I: Social Development (5 hours)

1. Concepts behind the origin of Family, Clan and Society

2. Different Social Systems
3. Relation between Human being and Society
4. Comparative studies on different models of Social Structures and their evolution

UNIT II: Political Development (3 hours)

1. Ideas of Political Systems as learnt from History
2. Different models of Governing system and their comparative study

UNIT III: Economic Development (18 hours)

1. Birth of Capitalism, Socialism, Marxism
2. Concept of development in pre-British, British and post British period- Barter, Jajmani
3. Idea of development in current context.
4. E. F. Schumacher's idea of development, Buddhist economics.
5. Gandhian idea of development. Swaraj and Decentralization.

***PROJECT: Possible projects in this course could be**

a) Interact with local communities and understand their issues.
b) Study local cottage industry and agricultural practices. Role of engineering and specialized knowledge.
c) Evaluation of technology in the context of its application. Social impact of technology. Enviromental impact of technology. Evaluation from a holistic perspective

HISTORY AND CIVILIZATION

1. GENERAL

1.1 COURSE TITLE: History and Civilization
1.2 *COURSE NUMBER: IH.**H104.**14
1.3 CONTACT HRS: 2-1-0, Credit 8
1.4 SEMESTER-OFFERED: Both
1.5 PRE-REQUISITES: None

2. OBJECTIVE

This course is one of the foundation courses of Humanities (in Foundation Area 1). Objective of this course is to make students aware of rich legacy of India and introduce history in the context of survival, political and cultural development. The course is to emphasize the role of history in understanding the concepts of civilization and its connection towards the evolution of future societies. It also gives an opportunity to explore the world civilization and understand the contemporary development.

3. COURSE TOPICS

UNIT I: Overview of Indian History (19 hours)

Two threads will be running while covering the topics

a) Study of history as a way to understand contemporary society
b) Study of history as development of ideas of humankind to understand future societies

1. Prehistoric Period (Earliest times to the formation of States) - Origin of technologies (Stone, Bronze & Iron), subsistence (food collection to food production) in context of survival, Development from Rural to Urban societies.
2. Empires of Ancient India – (Maurya, Kushan & Gupta): study of Governance, Culture achievements (epigraphs, Icons and Architecture).
3. Medieval Period – (Early Medieval dynasties: Pala, Chandela, Rshtrakuta, Chola) & The Mughals: Governance, Sculptures, Paintings, Architecture.
4. British Raj & Contemporary India as a study of decentralized society and industrial societies (comparative study), colonialism.

UNIT II: Sources of History & History Writing (3 hours)

These topics will be taught interspersed with unit I

1. Sources of History – Literary (Texts) & Archaeological (material remains): Nature, limitations.
2. Discoveries & Data retrieval – Methods and techniques of Archaeology (exploration, excavation, recording, dating); Scrutiny of textual narrations (contexts, linguistic, dating).
3. Interpretations & Historical Reconstructions – Identification of cultures, Analysis of data, Interpretative models, Ideological bias.

UNIT III: Survey of World Civilizations (4 hours)

Beginning to 1500 CE: Mesopotamia, Egypt, China.

4. READINGS

4.1 TEXTBOOK

1. India: A History by John Keay
2. Discovery of India by Pt. J. L. Nehru

4.2 *REFERENCE BOOKS

1. An Advanced History of India. By R.C. Majumdar, H.C. Raychaudhuri, and Kalikinkar Datta. 1946. London: Macmillan.
2. Bharat Mein Angreji Raj - Pundit Sunderlal

5.3 *PROJECT

Thematic projects to create larger picture of times and society. The following can be some of the projects:

- Choose one monument -- do in-depth research
- Choose one festival -- connect with communities and mythology
- Choose one inscription -- connect with historical times

- Choose one personality -- study the times, and how the individual copedwith difficulties. Example: Social leaders, scientists, authors, freedom fighters, and visionaries such as Mahamana Madan Mohan Malviya.
- Choose one city -- what makes the city alive
- Choose family histories
- Choose local oral history (e.g. legends, ballads)

6. OUTCOME OF THE COURSE

It is expected that after taking this course, students will be aware of the different facet of the evolution of societies in the past. It will also give them an opportunity to envisage the future societies and encourage an exploration of the role of technology in social developments.

SEMESTER-IV

MATHEMATICAL METHODS

1. GENERAL

1.1 COURSE TITLE: Mathematical Methods
1.2 *COURSE NUMBER: IS**.MA203.**14
1.3 CONTACT HRS: 3-1-0, Credits 11
1.4 *SEMESTER -OFFERED: Even
1.5 PREREQUISITE: Engineering Mathematics I
1.6 SYLLABUS OF COMMITTEE MEMBER: Dr. Subir Das (Convener), Dr. Rajeev

2. COURSE CONTENT

UNIT I: (12 Lectures)

Fourier transform, Laplace transform, Solution of differential equations by Laplace and Fourier transform methods, Applications of Laplace and Fourier transforms to Boundary value problems arising in Engineering Sciences.

UNIT II: (4 Lectures)

Hankel transform, Applications.

UNIT III: (4 Lectures)

Solutions of Laplace, Wave and Heat Conduction Equations.

UNIT IV: (8 Lectures)

Basic ideas of Discrete Fourier transform (DFT) and Finite Fourier transform (FFT), Z-transform, and Applications.

UNIT V: (7 Lectures)

Ordinary Differential Equations: Power series and Frobenius methods, Hermite functions, Bessel functions, Modified Bessel functions, Applications. Legendre polynomials, Associated Legendre polynomials, Rodrigues formula, Orthogonality of Legendre polynomials, Hermite functions and Bessel functions, Sturm-Liouville problem.

UNIT VI: (4 Lectures)

Concept and calculation of Green's function, Approximate Green's function, Green's function method for differential equations.

3. READINGS

3.1 TEXTBOOK:

1. O. Scherzer (Ed.), Handbook of Mathematical Methods in Imaging, Springer, 2011.
2. G. S. Rao and K. K. Reddy, Mathematical Methods, I.K. International Pvt. Ltd., 2009.
3. W.W. Bell, Special functions for scientists and engineers, D.Van Nostrand Company Ltd., London, 1968.
4. G. N. Watson, A Treatise on the Theory of Bessel Functions, Cambridge University Press, 1944.
5. G. F. Roach, Green's Functions, Cambridge University Press, 1995.
6. A. D. Poularikas, The Transforms and Applications Handbook, CRC Press, 1996.

ANALOG CIRCUITS AND SYSTEMS

1. GENERAL

1.1 COURSE TITLE: Analog Circuits and Systems

1.2 COURSE NUMBER: MC.**EO202**.15

1.3 CONTACT HRS: 3-0-3, Credit 12

1.4 SEMESTER OFFERED: 4th Semester

2. OBJECTIVE

The objective of this course is to introduce to the students the biasing and Stability of BJT circuits. It also talks about the low frequency and high frequency models of BJT. Single stage and Multi stage BJT amplifier analysis along with power amplifier will be discussed. Feed back and Oscillator will be discussed. In addition to these, the linear ICs will be taken up. Detail analysis of Operational Amplifier will be taken up. It will also include Timer, Voltage Regulator, VCO, PLL and Analogue switches will also be covered. ADC and DAC will be part of this course.

3. COURSE CONTENT

1. BJT small signal equivalent circuits

2. High frequency BJT model
3. Single stage BJT amplifier analysis
4. Multistage BJT amplifier analysis
5. Cascoding and Darlington pair
6. Feedback amplifiers
7. Power Amplifier
8. Oscillators
9. Operational Amplifiers (Characteristics, Internal structure, errors, linear and non-linear applications)
10. Timer NE 555 (Internal structure, working and applications)
11. Linear Voltage Regulator (Basic Theory, 78XX, 79XX and LM 723 with SMPS)
12. ADC and DAC
13. PLL and applications
14. Analogue switches

LABORATORY EXPERIMENTS

1. BJT biasing and stability
2. Designing a BJT amplifier
3. Designing a cascade amplifier
4. Op Amp 741-(Linear applications
5. Op Amp 741-C Non Linear applications
6. Timer NE 555 and applications
7. LM 723 and applications
8. LM 78XX and LM 79XX

4. READINGS

4.1 TEXT BOOK

1. Linear Integrated Circuits, D Roy Choudhury and S Jain, New Age International (P) Limited Publishers.
2. Electronic Devices and Circuits, J Millman, C C Halkias and S Jit, Tata Mc Graw Hill

4.2 REFERENCE BOOKS

1. Electronic Devices and Circuit Theory, Robert L Boylested and L Nashelsky, Prentice Hall of India.
2. Design with operational amplifiers and analog integrated circuits, Sergio Franco, Tata Mc Graw Hill

5. OUTCOME OF THE COURSE

At the end of this course, the students should be able to understand a circuit and find the bug. They should also be capable of designing a system with the given specification.

INSTRUMENTATION, MEASUREMENT AND ANALYSIS

1. GENERAL

1.1 COURSE TITLE: Instrumentation, Measurement and Analysis

1.2 *COURSE NUMBER: DC.**EP201**.15,

1.3 CONTACT HRS: 2-0-0, Credit 6

1.4 SEMESTER-OFFERED: Even

1.5 PRE-REQUISITE: None

1.6 SYLLABUS COMMITTEE MEMBER: Dr. A. Mohan (Convener), Prof. S. Chatterjee

2. OBJECTIVE

This course deals with the basic understanding of the instruments, their principle of operation, monitoring, and control action. To give the detailed knowledge about the behaviour of the instrument to static and dynamic conditions.

Elementary knowledge of Electronics is the prerequisite for this course.

3. COURSE CONTNT

General concepts of instruments: Monitoring and control action, functional elements of instruments, Classification of Instruments. **(4 Lectures)**

Static Performance Parameters: Resolution, threshold, accuracy, precision, static sensitivity, linearity, hysteresis, dead-band, backlash, drift. **(2 Lectures)**

Specifications of instruments: Generalized mathematical model of dynamic response of measurement systems. Operational transfer function, Sinusoidal transfer function, and Laplace transfer function. **(5 Lectures)**

Zero - order, first - order, and second - order instruments. Dynamic response of instruments: Step, ramp, and frequency response of first order and second order instruments. **(7 Lectures)**

Control system: Basic control actions, proportional, derivative and integral control, Transfer function of control system. **(8 Lectures)**

4. READINGS

4.1 TEXTBOOK

1. Measurment Systems by E.O.Doebelin and D.N.Manik, McGraw- Hill.1966.
2. Instrumentation, Measurement and Analysis by B.C. Nakra and K.K. Chaudhry,Tata McGraw-Hill, 1985.
3. Electronic Instrumentation by H.S.Kalsi, McGraw- Hill, 1995.
4. Automatic Control System by S.N. Verma, Khanna Publisher, 2004.
5. Automatic Control System, by B.C. Kuo, John Wiley Publisher, 2003.

4.2 *REFERENCE BOOKS

5. OUTCOME OF THE COURSE

Comprehensively understand the physics, concepts, operation, analysis, and applications of instruments. Students should be able to apply the knowledge to most simple to complex instruments that they deal with in their lab.

SOLAR AND SPACE PLASMA PHYSICS

1. GENERAL

1.1 COURSE TITLE: Solar and Space Plasma Physics

1.2 *COURSE NUMBER: DC.**PHY211**.15

1.3 CONTACT HRS: 3-0-0, Credit 9

1.4 SEMESTER-OFFERED: Even

1.5 PRE-REQUISITE: None

1.6 SYLLABUS COMMITTEE MEMBER: Prof. B. N. Dwivedi (Convener), Dr. A. K. Srivastava

2. OBJECTIVE

To explore the physical processes occurring in the space environment; solar wind propagation and its interaction with the Earth and comparison with satellites and ground-based observations; key elements of electromagnetic theory; Magnetohydrodynamics (MHD) and applications; the importance of solar and space plasma physics for modern day life; the magnetospheres of other planets compared to that of Earth.

3. COURSE CONTENT

The solar atmosphere, solar wind and interactions with planetary bodies. **(6 Lectures)**

The fluid theory of plasmas, frozen-in theorem. **(6 Lectures)**

The shape of the Earth's magnetosphere: the balance of thermal, dynamic and magnetic pressures. **(3 Lectures)**

Magnetic reconnection and energy flow in the magnetosphere. **(3 Lectures)**

Convection and substorm phenomena. **(3 Lectures)**

Coronal mass ejections and geomagnetic storms. **(3 Lectures)**

Ionosphere and plasmasphere. **(3 Lectures)**

Trapped particles, ring current and radiation belts. **(3 Lectures)**

Effects of terrestrial disturbance: satellite health and safety, satellite orbit prediction, disruption to communication, navigation, radar systems and power distribution networks. **(3 Lectures)**

Applications in fusion research and astrophysics. **(3 Lectures)**

4. READINGS

4.1 TEXTBOOK

1. Basic Space Plasma Physics, W. Baumjohann and R. Treumann, Imperial College Press, 1997.
2. Physics of Solar System Plasmas, T. E. Cravens, Cambridge University Press, 1997.
3. Dynamic Sun, ed. B.N. Dwivedi, Cambridge University Press, 2003, 2007.

4.2 *REFERENCE BOOKS

5. OUTCOME OF THE COURSE

After studying this course, students should be able to understand disturbances in the near-Earth space environment, apply fluid theory to large scale plasmas, understand Earth's space environment in relation to that of other planets have an introduction to current key research.

CONDENSED MATTER PHYSICS

1. GENERAL

1.1 COURSE TITLE: Condensed Matter Physics

1.2 *****COURSE NUMBER: DC.**PHY221**.15

1.3 CONTACT HRS: 3-0-2, Credit 11

1.4 SEMESTER-OFFERED: Even

1.5 PRE-REQUISITE: None

1.6 SYLLABUS COMMITTEE MEMBER: Prof. S. Chatterjee (Convener), Prof. P. Singh

2. OBJECTIVES

Basic knowledge of the physical properties of condensed phases of matter and to understand the behavior of these phases by using physical laws.

3. COURSE CONTENT

1. **Crystallography**: Crystalline and amorphous solids, translational symmetry. Elementary ideas about crystal structure, unit cell, fundamental types of lattices, Miller indices, lattice planes, simple cubic, f.c.c. and b.c.c. lattices. **(8 Lectures)**
2. **Structure of solids**: Different types of bonding- ionic, covalent, metallic, van der Waals and hydrogen. Band theory of solids, Periodic potential and Bloch theorem, Kronig-Penny model, energy band structure. Band structure in conductors, semiconductors and insulators (qualitative discussions). **(8 Lectures)**
3. **Dielectric properties of materials**: Electronic, ionic and dipolar polarizability, local fields, induced and oriented polarization – molecular field in a dielectric; Clausius-Mosotti relation. **(6 Lectures)**
4. **Magnetic properties of materials**: Dia, para and ferro-magnetism in solids. Theory of paramagnetism, Curie's law. Ferromagnetism: spontaneous magnetization and domain structure; temperature dependence of spontaneous magnetisation; Curie-Weiss law, explanation of hysteresis. **(9 Lectures)**
5. **Superconductivity:** Introduction (Kamerlingh-Onnes experiment), effect of magnetic field, Type-I and type-II superconductors, Isotope effect. Meissner effect. Heat capacity. Energy gap. Ideas about High-Tc Superconductors. **(8 Lectures)**

4. READINGS

4.1 TEXTBOOK

1. Solid State Physics: A. J. Dekker, Maxmillan & Co.
2. Solid State Physics: R. L. Singhal, Kedar Nath Ram Nath.

4.2 *REFERENCE BOOKS

1. Solid State Physics: C. Kittel, Wiley Edition

2. Solid State Physics: Aschroft and Mermin, Harcourt College Publishers.

5. OUTCOME OF THE COURSE

After completing this course the students will have basic idea on structure of materials, electrical and magnetic properties, and will learn superconductivity. .

UNIVERSAL HUMAN VALUES 2: SELF, SOCIETY AND NATURE

1. GENERAL

1.1 COURSE TITLE: Universal Human Values 2: Self, Society and Nature

1.2 COURSE NUMBER: HU.**H201**.14

1.3 CONTACT HRS: 1-2-0, Credits 5

1.4 SEMESTER-OFFERED: Even

1.5 PRE-REQUISITES: Universal Human Values 1: Self & Family (desirable); 4-day Harmony-2 Workshop (co-requisite).

2. OBJECTIVE

The objective of the course is four fold:

1. Sensitization of student towards issues in society and nature.
2. Understanding (or developing clarity) of nature, society and larger systems, on the basis of human relationships and resolved individuals.
3. Strengthening of self reflection.
4. Development of commitment and courage to act.

(For elaboration on some of the above, consult course description for Universal Human Values 1: Self and Family).

3. COURSE CONTENT

In Universal Human Values 2 course, the focus is more on understanding society and nature on the basis of self and human relationships.

- Purpose and motivation for the course.
- Recapitulation (from the previous course) on ideas of self, pre-conditioning, and natural acceptance.
- Harmony in the self. Understanding human being as co-existence of self and body. Identifying needs and satisfying needs of self and body. Self observations. Handling peer pressure.
- Recapitulation on relationships. Nine universal values in relationships. Reflecting on relationships in family. Hostel and institute as extended family. Real life examples.
- Teacher-student relationship. Shraddha. Guidance. Goal of education.
- Harmony in nature. Four orders of nature – material order, plant order, animal order and human order. Salient features of each. Human being as cause of imbalance in nature. (Film **"Home"** can be used.)

- Human being as cause of imbalance in nature. Depletion of resources – water, food, mineral resources. Pollution. Role of technology. Mutual enrichment not just recycling.
- Prosperity arising out of material goods and understanding of self. Separation of needs of the self and needs of the body. Right utilization of resources. lkekU; vkdka{kk ,oa egRokdka{kk,¡ Understanding the purpose they try to fulfil.
- Recapitulation on society. Five major dimensions of human society. Fulfilment of the individual as major goal. Justice in society. Equality in human relationships as naturally acceptable. Establishment of society with abhaya (absence of fear).
- Ethical human conduct. Values, character and netikataa.
- Professional ethics. Conduct as an engineer or scientist.
- Holistic human being through holistic education in just order.

4. READINGS

4.1 TEXT BOOK

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

4.2 REFERENCE BOOKS

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. On Education - J Krishnamurthy
6. Siddhartha - Hermann Hesse
7. Old Path White Clouds - ThichNhatHanh
8. On Education - The Mother
9. Diaries of Anne Frank - Anne Frank
10. Life and Philosophy of Swami Vivekananda
11. Swami Vivekananda on Himself
12. Small is Beautiful - E. F Schumacher.
13. Slow is Beautiful - Cecile Andrews.
14. Economy of Permanence - J C Kumarappa
15. Bharat Mein Angreji Raj - PanditSunderlal
16. Mahatma and the Rose
17. The Poet and the Charkha
18. Rediscovering India - by Dharampal
19. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
20. Swaraj by Arvind Kejriwal
21. India Wins Freedom - Maulana Abdul Kalam Azad
22. Ramakrishna kijeevani - Romain Rolland (English)
23. Vivekananda - Romain Rolland (English)

24. Gandhi - Romain Rolland (English)
25. Autobiography of a Yogi – by ParamhansaYogananda
26. Gandhi and Question of Science – Sahasrabudhe

5. OUTCOME OF THE COURSE

At the end of the course, students are expected to become more aware of their surroundings, society, social problems and their sustainable solutions, while keeping human relationships and human nature in mind. They would have better critical ability. They would also become sensitive to their commitment towards what they believe in (humane values. humane relationships and humane society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

SEMESTER-V

DIGITAL CIRCUITS AND SYSTEMS

1. GENERAL

1.1 COURSE TITLE: Digital Circuits and Systems
1.2 *COURSE NUMBER: MC.**EO 301**.16
1.3 CONTACT HRS: 3-0-3, Credit 12
1.4 SEMESTER-OFFERED: Odd
1.5 PREREQUISITE:
1.6 SYLLABUS COMMITTEE MEMBER: Dr. Amit Kumar Singh (Convener)

2. OBJECTIVE

To cover the fundamentals of Digital circuits and design considerations of digital systems.

3. COURSE CONTENT

Wave shaping circuits.

Wave generating circuits: Multi-vibrators and Schmitt Trigger, Frequency division and synchronizing techniques.

Sweep Generating circuits: Errors in sweep waveforms, Miller Integrator, Bootstrap techniques.

Digital Logic families: Bipolar and MOS Integrated circuits: Characteristics, Limitations and applications, Analysis of digital logic families: TTL, MOS, CMOS Invertors; interfacing between logic families; various logic functions and their implementations.

Synthesis of Combinational functions using standard logic gates/MSI modulo circuits.

Binary, BCD, Excess 3, Gray codes, Error detection and correction codes.

Flip Flops and Memory devices: RAM – Static and Dynamic, ROM, PROM, EPROM, EEPROM.

Counters and Shift registers: Binary, BCD and programmable modulo counters, Shift register, counters, Bistable circuits – R-S, J-K, D and PLA; Design of synchronous sequential circuits.

Sequential circuit design, System design using SSI and MSI building blocks.

Finite State Machine.

List of Laboratory experiments (3 hours/week):

1. Design of a BCD to excess 3-code converter using either NAND GATE or NOR GATE only.
2. Design a combinatorial circuit to compare the magnitude of two 2-bit binary number using only NOR GATE.
3. Design a combinatorial circuit using Multiplexer and also design with NAND/NOR GATE using Multiplexer (4:1).
   i. BCD to 7 segment display.
   ii. 4-bit ODD parity checker circuit.
4. Characteristic equation and their verification for different Flip-Flops.
5. Design of 4-bit synchronous counter (Mod X), where 8< x <15 and the count sequence is other then binary.
6. Realization of 2-bit UP/DOWN counter with set and reset facility using JK Flip-Flop.
7. (i) Study of left shift and right shift register.
   (ii) Design of PRBS (Pseudo Random Binary Sequence Counter)/MLS (Maximum Length Sequence)/ Non MLS generator.
8. ALU
9. Realization of an ordinary Mod-5 counter with count sequence 000, 001, 011, 010, 110, 000.

4. READINGS

4.2 TEXTBOOK

1. Digital Logic and Computer Design, M. Morris Mano, PHI
2. Pulse, Digital and Switching Waveforms, Jacob Millman and Herbert Taub, TMH.
3. Digital Circuits and Logic Design, S.C. Lee, PHI.
4. Gate to Microprocessor by S.K. Bose.
5. Digital Design by Roth.

4.2 *REFERENCE BOOKS

5. OTHER SESSIONS

5.1 TUTORIALS: No

5.2 LABORATORY: Yes (3 hours/week)

5.3 PROJECT: No

6. ASSESSEMENT

7. OUTCOME OF THE COURSE

ATOMIC AND MOLECULAR PHYSICS

1. GENERAL

1.1 COURSE TITLE: Atomic and Molecular Physics

1.2 *COURSE NUMBER: DC. **PHY301**.15

1.3 CONTACT HRS: 3-0-0, Credit 9

1.4 SEMESTER-OFFERED: Odd

1.5 PRE-REQUISITES: PHY-101: Classical, Quantum and Relativistic Mechanics

1.6 SYLLABUS COMMITTEE MEMBER: Dr. S. Upadhyay (Convener), Prof. D. Giri

2. OBJECTIVE

The aim of this course is to understand atomic structure, atomic & molecular spectra, the origin of orbital, molecular levels and transitions among these levels.

3. COURSE CONTENT

UNIT I: Atomic Physics

Orbital, spin & total angular momentum, space quantization, Stern–Gerlach experiment. **(3 Lecture)**

Spin-orbit interaction & fine structure, Hyperfine structure, Coupling schemes, spectroscopic terms and notation, selection rules, Intensity of spectral lines. **(5 Lectures)**

Idea of Normal and inverted doublets, Larmor precession, Normal and Anomalous Zeeman Effects, Paschen Back effect, Stark effect, Lamb Shift, Spectral line broadening. **(10 Lectures)**

UNIT II: Molecular Physics

Born-Oppenheimer approximation, types of molecule. **(2 Lectures)**

Pure rotational, pure vibrational, Vibration-rotation, Electronic transitions in diatomic molecules, Franck-Condon principle. **(10 Lectures)**

Rotational structure of electronic transitions, Fortrat diagram, Dissociation energy of molecules, Continuous spectra, Raman transitions and Raman spectra. **(6 Lectures)**

4. READINGS

4.1 TEXTBOOK

1. H. E. White, Introduction to Atomic Spectra, McGraw Hill Book Company.
2. C. N. Banwell, Fundamentals of Molecular Spectroscopy, Tata McGraw Hill, 1991.

3. G. Herzberg, Molecular Spectra and Molecular Structure Vol.I, D. Von Nostrand Company Inc.

5. OUTCOME OF THE COURSE:

Students will be able to understand the importance of analysis of spectrum, which in turn will provide a detailed picture of a particular atom or molecule, such as, bond length, force constant, anharmonicity constant, dissociation energy etc.

RELATIVISTIC ELECTRODYNAMICS

1. GENERAL

1.1 COURSE TITLE: Relativistic Electrodynamics
1.2 COURSE NUMBER: DE**.PHY 302.**15
1.3 CONTACT HRS: 3-0-0, Credit 9
1.4 SEMESTER -OFFERED: Odd
1.5 PRE-REQUISITE: PHY 102: Introduction to Engineering Electromagnetics
1.6 SYLLABUS COMMITTEE MEMBER: Dr. A. K. Srivastava (Convener), Dr. P. C. Pandey, Prof. O. N. Singh, Dr. Prasun Dutta.

2. OBJECTIVE

This course is designed such that the students learn about the covariant formulation of electromagnetic theory and its application. Students will also learn about different radiative systems, antenna etc. which are of practical importance.

3. COURSE CONTENT

- Review of Maxwell's equations **(1 Lecture)**
- Solution of Maxwell's equation using Green's function, Jefimenko's solution for Electric and Magnetic field. **(3 Lectures)**
- Need for special relativity, postulates of Special Relativity and concepts of intervals, space time diagram, proper time, Lorentz transformation, application of Lorentz Transformation (length contraction, time dilation, Doppler effect, velocity addition) **(7 Lectures)**
- Introduction to four vectors, covariant and contravarient components of Four vectors and their geometric meaning, concept of tensors, action for a free particle, relativistic dynamics. **(5 Lectures)**
- Action for the electromagnetic field and its interaction, introduction to electromagnetic field tensor, Maxwell's equation in covariant form, transformation of the electromagnetic fields, conserved quantities in Lorentz transformations. **(8 Lectures)**
- Energy-momentum tensor for the electromagnetic field, Poynting vector and conservation laws. **(4 Lectures)**
- Four potential of the electromagnetic field, Lienard-Wiechert potential, fields of accelerated point charge, synchrotron and bremsstrahlung radiation, multi-pole expansion of the potential. **(7 Lectures)**

- Radiation pattern of electric and magnetic dipoles, linear dipole antenna, antenna array, solving radiation pattern of different antenna configurations with numerical techniques (Fourier transform, finite element analysis). **(4 Lectures)**

4. READINGS

4.1 TEXTBOOK:

1. Classical Electrodynamics (3rd Edition) Author: John David Jackson
2. The Classical Theory of Fields, Volume 2 (4th Edition) Author: L. D. Landau and E. M. Lifshitz

4.2 REFERENCE BOOKS:

1. Introduction to Electro Dynamics (4th Edition) Author: David J. Griffiths.
2. Classical Electricity and Magnetism (2nd Edition) Author: Wolfgang K. H. Panofsky & Melba Phillips.
3. The Feynman Lectures on Physics (2nd Edition) Author: R. P. Feynman, R. B. Leighton & M. Sands.
4. Optics (4th Edition) Author: Eugene Hecht
5. Electromagnetic Fields and Waves (2nd Edition) Author: P. Lorrain and D. Corson
6. Einstein's Theory of Relativity (Revised Edition) Author: Max Born

5. OUTCOME OF THE COURSE:

The advanced knowledge of electrodynamics will support to pursue further studies in various fields of physical sciences (e.g., high energy physics, astrophysics etc.) as well as in R&D part of some Engineering fields (e.g., space, Communication, etc.).

V- SEMESTER ELECTIVE / STREAM COURSES (DE-I)

BIOPHYSICS

1. GENERAL

1.1 COURSE TITLE: Biophysics
1.2 COURSE NUMBER: DE**.EP 341.**15
1.3 CONTACT HRS: 3-0-0 - Credit 9
1.4 SEMESTER -OFFERED: odd
1.5 PRE-REQUISITE: No prerequisite
1.6 SYLLABUS COMMITTEE MEMBER: Dr. A.S. Parmar (C), Prof. D. Giri, Dr. (Mrs.) S. Mishra

2. OBJECTIVE

Objectives of the course are to study biological phenomena using physical principles. Introduction to how physical principles offer insights into modern biology, with regard to the structural, dynamical, and functional organization of biological systems.Physics has been very successful at illuminating fundamental aspects of biological problems at the molecular level.

3. COURSE CONTENT

Forces and energies at biological length scales (3 Lectures)

a. Intermolecular interactions and electrostatic screening

b. Chemical bonding and stability of molecules.

Transport Processes (5 Lectures)

a. Diffusion

b. Thermal conduction

c. Viscosity

Composition of living organisms (2 Lectures)

a. Carbon

b. Water

c. Biological polymers: DNA, RNA, Proteins, etc.

Proteins: Structure and Function (8 Lectures)

a. Structural organization of proteins: primary, secondary, tertiary and quaternary

b. Varieties of proteins: globular and fibrous.

c. Protein folding and unfolding

d. The stability of proteins and denaturation.

e. Protein Aggregation

Nucleic Acid and Genetic Information (5 Lectures)

a. Why a double helix?

b. How structure stores information.

c. The replication process.

d. From DNA to RNA to protein.

e. How DNA is packed in the cell nucleus.

The Cell (5 Lectures)

a. Cell components: membranes, cytoskeleton, organelles.

b. role of macromolecules: proteins, nucleic acid, carbohydrates.

c. Surface tension and mechanical properties of cell membranes.

d. Brownian motion and viscosity and their influence on particle motion in the cell.

e. Molecular crowding

e. Energy and information flow in the cell.

The cell membrane (4 Lectures)

a. Molecular architecture of the cell membrane.

b. Transport across cell membranes.

The Neuron (7 Lectures)

a. Nerve signals.

b. Generation and propagation of the action potentials.

c. The role of channels and pumps.

d. The biophysics of the synapse.

4. READINGS

4.1 TEXTBOOK:

1. Biological Physics: Energy, Information, Life by Philip Nelson
2. Biophysics: An Introduction by Rodney Cotterill

4.2 REFERENCE BOOKS:

1. Physical Biology of the Cell by Rob Phillips and Jane Kondev (Garland Science)
2. Newton rules biology : a physical approach to biological problems' by C.J. Pennycuick (Oxford University Press)

5. OUTCOME OF THE COURSE:

It will provide a modern view of molecular and cellular biology as seen from the perspective of physics, and quantified through the analytical tools of physics. It will also prepare students to carry out research in field of Biophysics, Biotechnology, Biomedical and Bio-nanotechnology.

RENEWABLE ENERGY SOURCES

1. GENERAL

1.1 COURSE TITLE: Renewable energy sources

1.2 *COURSE NUMBER: DE.**EP351**.15

1.3 CONTACT HRS: 3-0-0, Credit 9

1.4 SEMESTER-OFFERED: Odd

1.5 PRE-REQUISITES: None

1.6 SYLLABUS COMMITTEE MEMBER: Prof. P. Singh (Convener), Dr. N. Agnihotri

2. OBJECTIVE

This course aims to introduce about the awareness of the present world energy scenario and available options required to meet the demand of energy.

3. COURSE CONTENT

The Present world energy scenario, Alternative options, Solar energy, Solar radiation, Solar Thermal Applications, Flat Plate collector, Solar air heater, Solar concentrator. **(12 Lectures)**

Energy storage, Photovoltaics and its applications, Solar cells, Module, panel and Array constructions. **(10 Lectures)**

Wind energy, Bio-mass and Bio-gas energy, Geothermal energy, Ocean energy, Hydro resources. **(5 Lectures)**

Emerging technologies; fuel cells, hydrogen energy. **(6 Lectures)**

Non-conventional technologies; Magnetohydrodynamics, thermoelectric power conversion, thermionic power conversion. **(6 Lectures)**

4. READINGS

4.1 TEXTBOOK

1. Non-Conventional Energy Resources: B.H KHAN, Mcgraw Hill Education
2. Renewable Sources of Energy and Conversion Systems:N.K.Bansal and M.K.Kleeman.

3. Energy for a sustainable world: Jose Goldenberg, Thomas Johansson, A.K.N.Reddy, Robert Williams (Wiley Eastern).
4. Solar Energy Handbook: Kreith and Kreider (McGrawHill)
5. SOLAR Energy: SUKHATME, Mcgraw Hill Education.
6. Solar Cell : Marteen A. Green.
7. Solar Hydrogen Energy Systems -T. Ohta (Ed.) (Pergamon Press).
8. Handbook : Batteries and Fuel cell – Linden (Mc.Graw Hill)

4.2 *REFERENCE BOOKS

5. OUTCOME OF THE COURSE

Students are expected to learn the science and technology of various non conventional energy sources as well as the conventional energy sources.

REMOTE SENSING

1. GENERAL

1.1 COURSE TITLE: Remote Sensing
1.2 COURSE NUMBER: DE**.EP361.**15
1.3 CONTACT HRS: 3-0-0, Credit 9
1.4 SEMESTER -OFFERED: Odd
1.5 PRE-REQUISITE: Basic course on Electromagnetism
1.6 SYLLABUS COMMITTEE MEMBER: Prof. Prabhakar Singh

2. OBJECTIVE

Its objective is to provide basic understanding of physics and techniques for remote sensing to acquire information about land use land cover.

3. COURSE CONTENT

UNIT I: Physics of remote sensing

3 orbits. **(15 Lectures)**

UNIT II: Sensors and platforms

Classification of sensors, active and passive sensors, scale, resolution of sensors-spectral, spatial, radiometric and temporal and mapping units, observation platforms: ground, airborne and space-borne. **(6 Lectures)**

UNIT III: Remote sensing antennas

Reciprocity, far field region, antenna pattern, beam dimensions, antenna directivity, antennas gain, radiation efficiency, effective area of receiving antenna, Friis transmission formula. **(6 Lectures)**

UNIT IV: Radar scattering models for remote sensing

Radar return from characteristic surfaces, effect of dielectric properties of targets on radar return, surface and volume scattering, influence of system and target parameters on imagery gray tones, parameters affecting radar return signal, smooth surface criteria, , scattering models for soil surfaces, angular response, roughness response and moisture response, scattering models for vegetation canopy, first order solution of radiative transfer model, first order model for multi-constituent canopy. **(12 Lectures)**

4. READINGS

4.1 TEXTBOOK:

1. Microwave Radar and Radiometric Remote Sensing, by F. T. Ulaby and David G. Long, The University of Michigan Press, USA.
2. Microwave Remote Sensing Active & Passive, Vol. I, II, IV by F.T. Ulaby, R.K. Moore & A.K. Fung, Addision-Wesley Publishing Company, Massachusetts. USA.

4.2 REFERENCE BOOKS:

1. Introduction to the Physics & Techniques of Remote Sensing by Charles Elachi, John Wiley & Sons, New York.
2. Remote Sensing & its Applications by L.R.A. Warayan, University Press (India) Ltd. Hyderabad

5. OUTCOME OF THE COURSE: The students would be able to understand the physical phenomenon occur in remote sensing. They may understand the sensors and antenna properties useful in remote sensing for acquiring information about distant object without coming in to contact.

SEMESTER-VI

STATISTICAL PHYSICS

1. GENERAL

1.1 COURSE TITLE: Statistical Physics

1.2 *COURSE NUMBER: DC.**PHY303**.15

1.3 CONTACT HRS: 3-0-0, Credit 9

1.4 SEMESTER-OFFERED: Even

1.5 PRE-REQUISITE: Basic Physics Courses at first year level

1.6 SYLLABUS COMMITTEE MEMBER: Prof. D. Giri (Convener), Dr. S. K. Mishra

2. OBJECTIVE

To introduce the probability concept and basic understanding of equilibrium statistical physics (both classical and quantum) with few applications to systems of non-interacting particles. Basic ideas of phase transitions and critical phenomena will also be introduced.

3. COURSE CONTENT

- Brief review of thermodynamics. **(3 Lectures)**

- Random walk problem and basic probability theory; Concept of phase space; Micro and macro states; Ergodic hypothesis; Liouvelle's theorem. **(6 Lectures)**
- Ensemble theory: Micro-canonical, Canonical and Grand-canonical Ensemble, Partition function, Free energy & thermodynamic relations; Application to simple systems; Monte Carlo method in statistical physics. **(10 Lectures)**
- Quantum Statistics: Boltzmann, Bose-Einstein and Fermi-Dirac statistics and its applications. **(10 Lectures)**
- Phase transition and Critical phenomena; Renormalization group theory. **(10 Lectures)**

4. READINGS

4.1 TEXTBOOK

1. Statistical Mechanics by R. K. Patharia, Butterworth-Heinemann Pub.
2. Introductory Statistical Mechanics by R. Bowely and M. Sanchez, University Press (NewYork).
3. Statistical Mechanics by K. Huang, John Wiley & Sons (New York).

4.2 *REFERENCE BOOKS

1. Fundamentals of Statistical and Thermal Physics by F. Reif, Mc-Graw Hill Int. Eds.
2. Introduction to Phase transitions and Critical Phenomena by H. E. Stanley, Oxford Univ. Press, USA.
3. Introduction to Modern Statistical Mechanics by D. Chandler, Oxford University Press, USA.

5. OUTCOME OF THE COURSE

Students will be able to apply the principles of statistical mechanics and apply techniques to a range of problems in Physics.

COMPUTATIONAL PHYSICS

1. GENERAL

1.1 COURSE TITLE: Computational Physics

1.2 *COURSE NUMBER: DC.**PHY 304**.15

1.3 CONTACT HRS: 2-0-3, Credit 09

1.4 SEMESTER-OFFERED: Even

1.5 PRE-REQUISITE: Basics Computer programming

1.6 SYLLABUS COMMITTEE MEMBER: Prof. D. Giri (Convener), Dr. S. K. Mishra, Dr. A. K. Srivastava, Dr. P. Dutta, Dr. S. Mishra, Dr. R. Singh

2. OBJECTIVE

To introduce the basic ideas of numerical techniques and programming. Basic ideas of simulation techniques and parallel programming concepts will also be introduced.

3. COURSE CONTENT

Basic numerical methods with application to physics:

Introduction to scientific computing: Representation of numbers in computers; programming languages, compiled vs interpreted languages; errors, accuracy and stability in computation. **(02 Lectures)**
Numerical Root finding: Bisection, Secant and Newton-Raphson Methods. **(02 Lectures)**
Interpolation and differentiation: Linear and Spline interpolation, numerical Differentiation. **(03 Lectures)**
Integration: Trapezoidal, Simpson's and Gaussian Quadratures methods. **(03 Lectures)**
Ordinary Differential Equations: Euler, second and fourth order Runge-Kutta methods. **(02 Lectures)**
Numerical Linear Algebra: Gaussian elimination, LU decomposition methods. **(03 Lectures)**
Modeling of Data: Maximum likelihood estimators, least square and chi square estimation, confidence interval. **(03 Lectures)**
Monte-Carlo techniques: Random number generation, Monte-Carlo integrations, Metropolis algorithm, application to 2D-Ising models. **(04 Lectures)**
Molecular Dynamics: Verlet and Runge-Kutta integration. **(02 Lectures)**
Parallel Computing: Introduction to OpenMP and MPI. **(02 Lectures)**

Additional Lab Topics:
Apart from implementation of the above methods, the following topics will also be covered in Lab sessions.
• Introduction to Python including matplotlib for plotting.
• Introduction Atlas device simulator.
• Symbolic computation using python package sympy.

Preferred Software Platform: Anaconda Python (https://www.continuum.io/)

4. READINGS

4.1 TEXTBOOK

1. An Introduction to Computational Physics, Tao Pang, 2nd edition.
2. Computational Physics, J. M. Thijssen, (Cambridge, 2007).
3. Numerical Methods for Physics, 2nd Edition, Alejandro L. Garcia (Prentice Hall, Upper Saddle River, NJ, 2000).
4. A First Course in Computational Physics, Paul L. DeVries and Javier E. Hasbun (Jones & Bartlett, Burlington, MA, 2010).

4.2 *REFERENCE BOOKS

1. Computational Physics, Rubin H. Landau, Manuel J. Paez, and Cristian C. Bordeianu (Wiley-VCH, Weinheim, 2007).
2. Understanding Molecular simulations, D. Frenkel and B. Smith, (Academic press, 2002).
3. William H. Press, Saul A. Teukolsky, William T. Vetterling and Brian P. Flannery, Numerical Recipes: The Art of Scientific Computing, 3rd edition.
4. Morten Hjorth-Jensen, Computational Physics Lecture Notes (available online at http://www.uio.no/studier/emner/matnat/fys/FYS3150/h09/undervisningsmateriale/Lecture%20Notes/lectures2009.pdf).
5. Rubin H. Landau, Manuel J. Páez and Cristian C. Bordeianu, Computational

Physics: Problem Solving with Python, 3rd edition.

5. OUTCOME OF THE COURSE

Students will be able to learn basic numerical techniques and algorithms which will help them to solve computationally wide range of problems in physics & engineering.

VI- SEMESTER ELECTIVE / STREAM COURSES (DE-2)

ADVANCED QUANTUM MECHANICS

1. GENERAL

1.1 COURSE TITLE: Advanced Quantum Mechanics

1.2 COURSE NUMBER: DE.**PHY 305**.15

1.3 CONTACT HRS: 3-0-0, Credit 9

1.4 SEMESTER-OFFERED: Even

1.5 PRE-REQUISITE: PHY 201: Quantum Physics

1.6 SYLLABUS COMMITTEE MEMBER: Dr. S. K. Mishra (Convener), Prof. D. Giri, Prof. S. Chatterjee, Dr. (Mrs.) S. Mishra, Dr. P. Dutta

2. OBJECTIVE

The aim of this course is to develop understanding of advanced techniques and ideas in Quantum Mechanics.

3. COURSE CONTENT

- Review of Quantum Mechanics **(4 Lectures)**
- Overview of Symmetries and Operators in Quantum Mechanics **(4 Lectures)**
- Motion of charged particles in electromagnetic fields **(3 Lectures)**
- Feynman path integrals **(2 Lectures)**
- Second Quantization **(2 Lectures)**
- Einstein-Podolosky-Rosen (EPR) paradaox, Schordinger's Cat, Bell inequalities. **(5 Lectures)**
- Quantum Entanglement and Computing **(10 Lectures)**
- Relativistic Quantum Mechanics **(8 Lectures)**

4. READINGS

4.1 TEXTBOOK:

1. R. Shankar, 'Principles of Quantum Mechanics', Plenum Press, 1994
2. J. J. Sakurai, 'Modern Quantum Mechanics', Addison Wesley, 1985
3. D. J. Griffiths, 'Introduction to Quantum Mechanics' Addison Wesley, 2 edition
4. E. Merzbacher, 'Quantum Mechanics', John Wiley & Sons, 1970

4.2 REFERENCE BOOKS:

1. J. J. Sakurai, 'Advanced Quantum Mechanics', Addison Wesley, 1967

2. M. A. Nielsen and I. L. Chuang, 'Quantum Computation and Quantum Information', Cambridge University Press, 2000

5. OUTCOME OF THE COURSE:

This course will enthuse the students regarding Quantum Mechanics and its application. Students will learn fundamentals of Quantum fields, Entanglement, Quantum Computing and path integral formulation of Quantum Mechanics.

INTRODUCTION TO ASTRONOMY AND ASTROPHYSICS

1. GENERAL

1.1 COURSE TITLE: Introduction to Astronomy and Astrophysics

1.2 COURSE NUMBER: DE.**PHY 311**.15

1.3 CONTACT HRS: 3-0-0, Credit 9

1.4 SEMESTER-OFFERED: Even

1.5 PRE-REQUISITE: PHY 101: Classical Quantum and Relativistic Mechanics, MA 203: Mathematical Method.

1.6 SYLLABUS COMMITTEE MEMBER: Dr. Prasun Dutta (Convenor), Dr. A. K. Srivastava, Prof. B. N. Dwivedi, Dr. A. Mohan.

2. OBJECTIVE

Astronomy requires knowledge of almost all branches of basic physics. This course is designed to demonstrate how observations of different phenomena at the largest scales in our universe are done and how they can be explained using our understanding of the basic physical laws. At the same time the course is supposed to provide an umbrella view of the entire field of astronomy, astrophysics and cosmology to the students. Some topics will be introduced with relatively more rigour such that the students also understand the difficulties and challenges in the subject.

3. **COURSE CONTENT**

1. **Overview of astronomy and cosmology**: **(1 lecture)**
2. **Astrometry**: Measurement of position, time, magnitude, colour and their implications. **(2 lectures)**
3. **Radiative processes in astrophysics**: Radiative transfer equation and its solution for simple cases, astronomical sources of radiations, thermal and non thermal radiation, observational signatures of different types of radiation. **(5 lectures)**
4. **Stelar structure and evolution:** H-R diagram and its implication, basic stellar equations, understanding of stellar structure and evolution by dimensional analysis, stellar evolution in and out of main sequence, Chandrasekhar limit. Star formation, Jeans theory, initial mass function. **(7 lectures)**
5. **Compact stars:** Black holes, neutron stars and pulsars, observational signatures. **(1 lectures)**
6. **Astronomical techniques, coherent and incoherent detections:** Basic detection techniques, incoherent detection with emphasis on optical astronomy, coherent detection

with emphasis on radio astronomy. **(7 lectures)**

7. **Galaxy, galactic dynamics:** Types of galaxies, stellar orbits, stability of a rotating disk, rotation curve and dark matter, origin of spiral structures, density wave theory, Toomre criteria for stability of the disk. **(5 lectures)**
8. **Interstellar Medium:** Constituent of ISM, thermodynamics of ISM and various phases, moment maps and their implications, metallicity and star formation rate, turbulence in the ISM. **(4 lectures)**
9. **Active galactic nuclei and radio galaxies:** Introduction to AGN and radio galaxies, observational signature and models. **(1 lecture)**
10. **Cosmology:** Hubble's law, Cosmic distance scales, redshift-distance relations, Friedman equation, its solution and implications, Thermal history of the universe, Nucleosynthesis, CMB and reionization, Galaxy formation and evolution. **(5 lectures)**

4. READINGS

4.1 TEXTBOOK

1. Physical Universe *by Frank Shu (University Science Books)*
2. An Introduction to Modern Astrophysics *by Bradley Caroll and Dale A. Ostile (Addison-Wesley; 2nd edition)*
3. Theoretical Astrophysics *by T. Padmanabhan (vol I, II, III) (Cambridge University Press; 1st edition)*

4.2 REFERENCE BOOKS:

1. To Measure the sky *by F. R. Chromey (Cambridge University Press; 1st edition)*
2. *Radiative Processes in Astrophysics by G. B. Ribicki and P. Lightman (*Wiley-VCH)
3. Tools of Radio Astronomy *by T. L. Wilson, K. Rohlfs and S. Huttemeister (Springer; 5th ed. edition)*
4. Theory of Stellar structure and evolution *by D. Prialnik (Cambridge University Press; 2nd edition)*
5. Galactic Dynamics *by J. Binney and S. Tremaine, (Princeton University Press; 2nd edition)*
6. Physics of the Interstellar and Intergalactic medium *by B. Draine (Princeton University Press)*
7. An Introduction to Active Galactic Nuclei *by B. Peterson. (Cambridge University Press; 1st edition)*
8. Cosmology *by S. Weinberg (Oxford University Press; 1st edition)*
9. Galaxy formation and Evolution *by H. Mo, van den Bosch and S. White. (Cambridge University Press; 1 edition)*

5. OUTCOME OF THE COURSE:

It is expected that the students would have a broad overview on the basic topics in astronomy, astrophysics and cosmology with more emphasis on some of the topics. They will understand the basic philosophy behind the subject which will help them decide if they would like to work in related areas in future.

PHYSICS OF MATERIALS

1. GENERAL

1.1 COURSE TITLE: Physics of Materials

1.2 *COURSE NUMBER: DC.**PHY321**.15

1.3 CONTACT HRS: 3-0-0, Credit 9

1.4 SEMESTER-OFFERED: Even

1.5 PRE-REQUISITES: EP221: Condensed Matter Physics

1.6 SYLLABUS COMMITTEE MEMBER: Dr. S. Upadhyay (Convener), Prof. S. Chatterjee, Dr. S. Tripathi

2. OBJECTIVE

To give exposure about physical concepts related to the structure and properties of the materials.

3. COURSE CONTENT

Unit 1.

Crystallography: Types of bonding, Elements of crystallography, Introduction to Point and Space groups, Reciprocal lattice concept, Structure by x-ray and neutron diffraction techniques. **(6 Lectures)**

Unit 2.

Defects in crystals: Impurities, vacancies, Schottky and Frenckel vacancies, extrinsic vacancies, colour centers, colorations of crystals, F-centers and V-centers, geometry of dislocation, edge and screw dislocations, burger vector, stacking fault, grain boundaries, twin boundaries, low and high angle boundaries, voids. **(6 Lectures)**

Unit 3.

Mechanical properties of Materials: Concept of stress and strain, Elastic and plastic deformation, Hardness, Creep, Brittle fracture in ceramics and glasses, Toughening of ceramics and composites, Fatigue, Mechanical testing. **(4 Lectures)**

Unit 4.

Diffusion in solids: Fick's law of diffusion, Kirhendall effect, atomic models of diffusion, other diffusion processes. **(4 Lectures)**

Unit 5.

Electrical properties of materials: Free electron theory of metals, Electrical conduction, Wiedemann Franz'a Law. Electrons in a periodic lattice: Bloch theorem, Effective mass. Fermi surfaces. Tight binding, Dielectrics: Types of polarization, Frequency and temperature dependence of polarization, Dielectric loss, dielectric breakdown, uses of dielectric materials, ferroelectricity, piezoelectricity and Applications. **(10 Lectures)**

Unit 6.

Thermal and Optical properties of materials: Heat capacity, Thermal expansion, Thermal conductivity, Thermal stresses, Refraction, Transmission, Reflection, Absorption, Colour, Luminescence, Photoconductivity, and applications. **(8 Lectures)**

4. READINGS

4.1 TEXTBOOK:

1. Solid State Physics, C. Killel, Wiley Edition.
2. Solid State Physics, A.J. Dekker, Macmillan and Company.
3. Solid State Physics, S.O. Pillai, New Age International Pvt. Ltd.

4.2 *REFERENCE BOOKS:

1. V. Raghavan, Materials Science and Engineering, Prentice-Hall of India Private Limited (2003).
2. Solid State Physics, Aschroft and Mermin, Harcourt College Publishers.

5. OUTCOME OF THE COURSE:

After attending this course, students will be able to understand the basic structure of materials and their applications in various fields of science and technology.

ADVANCED OPTICAL FIBER & COMPONENTS

1. GENERAL

1.1 COURSE TITLE: Advanced Optical Fiber and Components

1.2 *COURSE NUMBER (if known): DC.**EP 331**.15

1.3 CONTACT HRS: 2-0-3, Credit 9

1.4 SEMESTER-OFFERED: Even

1.5 PRE-REQUISITES: EO-237: Fiber Optics

1.6 SYLLABUS COMMITTEE MEMBER: Dr. P. C. Pandey (Convener), Prof. O. N. Singh, Dr. U. N. Singh

2. OBJECTIVE

This course illustrates the advancement in the field of optical fibers, different kind of optical fibers, and non linearity in optical fibers. It also exposes the students about the amplification and components for the optical fiber

3. COURSE CONTENT

- Single mode fiber: Mode field diameter, power confinement and mode cutoff, Intrinsic & Extrinsic loss, Coping with Dispersion. **(4 Lectures)**
- Polarisation Maintaining Fibers (PMF):Types of PMF, high birefringent fiber, single polarisation single mode fiber, **(4 Lectures)**
- Periodic optical fiber: coupled mode analysis, Bragg's reflector. **(4 Lectures)**
- Photonic crystal fiber: Solid core PCF and Holy PCF, **(4 Lectures)**
- Optical time domain refractometry (OTDR). **(2 Lectures)**
- Non linear effect in optical fiber: Non linear optical effects leading to solitons, theory of Soliton propagation, Properties of soliton for communication, Non linear effect in single mode fiber. **(8 Lectures)**
- Optical Amplifiers: Semiconductor optical amplifiers, Er-doped fiber amplifiers (EDFAs) **(4 Lectures)**
- Introduction of Light sources, transmitters and receivers for optical fiber communication. **(6 Lectures)**

4. READINGS

4.1 TEXTBOOK:

1. A.K. Ghatak & K. Thyagarajan, Introduction to Fiber Optics, Cambridge University Press (1998).
2. J. M. Senior, Optical Fiber Communication, Prentice Hall (1999).
3. G. Keiser, Optical Fiber Communications, McGraw Hill (2000).

4.2 *REFERENCE BOOKS:

1. K. Okamoto, Fundamentals of Optical Waveguides, Academic Press, (2000).
2. D.K. Mynbaev and LL Scheiner, Fiber-Optic Communications Technology, Pearson
3. John A. Buck, Fundamentals of Optical Fibers, Wiley Inter science, (2004).

5. OUTCOME OF THE COURSE:

After completing this course the students will be able to understand the advancement and Physics of different kind of optical fibers with their applications. Students will also be able to calculate learn about the components required in the application of optical fiber.

BIOPHYSICAL TECHNIQUES

1. GENERAL

1.1 COURSE TITLE: Biophysical Techniques

1.2 *COURSE NUMBER: DE.**EP342**.15

1.3 CONTACT HRS: 3-0-0, Credit 9

1.4 SEMESTER-OFFERED: Even

1.5 PRE-REQUISITES: NO

1.6 SYLLABUS COMMITTEE MEMBER: Dr. A.S. Parmar (C), Prof. D. Giri, Dr. Sunil Kumar Singh

2. OBJECTIVE

Introduce the students to a wide variety of physical techniques used in modern biophysics research. Biophysical techniques are central to the measurement of the atomic structure, dynamics and interactions of molecules that are a core foundation of biology systems. These techniques help us to understand the behavior of biomolecules and also achieve a mechanistic understanding of how they work. These techniques are very often used in field of Materials Science also.

3. COURSE CONTENT

Introduction (2 Lectures)

a. Biological Systems

b. Importance of Biophysical Techniques

Application of Light Scattering (6 Lectures)

a. Static Light Scattering

b. Dynamic Light Scattering

c. Electrophoretic Light Scattering

Importance of Spectroscopy for Biological Systems (9 Lectures)

a. UV-Vis, Spectrophotometer, Spectrofluorometer

b. Circular Dichroism, Fourier transform infrared spectroscopy

c. Raman spectroscopy, Fluorescence Correlation Spectroscopy

Introduction to Magnetic Resonance (4 Lectures)

a. Nuclear Magnetic Resonance

b. Electron Spin Resonance

Microscopy: Technique to answer many questions (8 Lectures)

a. Fluorescence Microscopy, Confocal Microscopy

b. Transmission Electron Microscopy, Scanning Electron Microscopy
c. Atomic Force Microscopy
d. Multiphoton Microscopy

Calorimetric Techniques (4 Lectures)
a. Differential Scanning Calorimetry (DSC)
b. Isothermal Titration Calorimetry (ITC)

Single molecule techniques for detecting physical properties of single molecule (6 Lectures)
a. TIRF
b. Optical Tweezers
c. Fluorescence Resonance Energy Transfer

4. READINGS

4.1TEXTBOOK

1. Introduction to Experimental Biophysics: Biological Methods for Physical Scientists by Jay Nadeau, CRC Press

4.2 *REFERENCE BOOKS

1. Cox, M.M, Nelson, D.L., Lehninger Principles of Biochemistry, W.H. Freeman & Co, 2009.
2. Stryer, L., Berg, J.M., Tymoczko, J.L., Biochemistry, W.H.Freeman& Co Ltd 2012
3. Voet, D., Voet, J.G., Pratt, C.W., Fundamentals of Biochemistry: Life at the Molecular Level, Wiley,2012
4. Creighton, T.E., Proteins: Structures and Molecular Properties, W H Freeman & Co; 3rd Ed., 2013
5. Circular Dichoism – Principles and Application, Edited by Brova, N., Nakanishi, K., Woody, R. W., Wiley, 2nd Ed., 2000.
6. Lakowicz, J. R., Principles of Fluorescence Spectroscopy, Springer, New York, 2006.

5. OUTCOME OF THE COURSE

It will introduce all the major techniques used in biophysical field which has applications in many fields like Biophysics, Biomedical & Biochemical Engineering, Chemistry and Materials Science. It will also prepare students for advanced biophysics course and also to carry out research in field of Biophysics, Biotechnology, Biomedical & Bio-nanotechnology, Materials Science and Chemistry.

MICROWAVE REMOTE SENSING

1. GENERAL

1.1 COURSE TITLE: Microwave Remote Sensing
1.2 COURSE NUMBER: DE.**EP362**.15
1.3 CONTACT HRS: 2-0-3, Credit 9
1.4 SEMESTER-OFFERED: Even
1.5 PRE-REQUISITE: Basic course on Electromagnetism

1.6 SYLLABUS COMMITTEE MEMBER: Prof. R. Prasad (Convener), Prof. Prabhakar Singh

2. OBJECTIVE

Its objective is to provide fundamental understanding about scattering and absorption losses of microwave during propagation in the atmosphere. The main objective of this course is to introduce the theoretical, technical and applied aspects of microwave remote sensing for monitoring and managing earth resources in general and crop monitoring in particular.

3. COURSE CONTENT

UNIT I: Microwave interaction with atmospheric constituents

Atmospheric composition, temperature profile, density profile, pressure profile, water vapour density profile, absorption and emission by gases, shape of spectral line, absorption spectrum, oxygen spectrum, water vapour spectrum, total gaseous spectrum, opacity of the atmosphere, electromagnetic interaction with individual spherical particles, Mie scattering, Rayleigh approximation, dielectric properties of hydrometeors, extinction and scattering properties of clouds, fog and rain. **(12 Lectures)**

UNIT II: Microwave radiometry

Theory of radiative transfer, brightness temperature of a stratified medium and scatter free medium, upwelling and downwelling atmospheric temperature, emission by a specular and rough surface, extreme surface conditions, specular and Lambertian surface. **(5 Lectures)**

UNIT III: Surface scattering models for remote sensing

Fresnel's reflection coefficient, RMS height, surface correlation length, RMS slope, smooth surface criteria, surface scattering models, I^2EM parameters, role of correlation function, RMS height, correlation length, dielectric constant, polarization ratios, scattering by random and periodic surfaces, backscattering by periodic surfaces. Model behaviour, polarimetric radar inversion for soil moisture, soil moisture assessment radar technique. **(12 Lectures)**

UNIT VI: Volume scattering models for remote sensing

Single scattering model for vegetation, direct ground contribution, direct volume contribution-The Cloud Model, canopy ground contributions, ground canopy ground contribution, single scattering radiative transfer model, Isotropic and Rayleigh scatterers. Penetration depth, radiative transfer theory, radar observation of vegetation canopies, propagation properties of cultural vegetation, extinction by a canopy containing stalks, role soil surface contribution, backscattering coefficient relationship to leaf area index, backscattering coefficient relationship to canopy water content. **(10 Lectures)**

4. READINGS

4.1 TEXTBOOK:

1. Microwave Radar and radiometric Remote Sensing, by F. T. Ulaby, Univerisity of Michigan Press, USA.
2. Microwave Remote Sensing Active & Passive, Vol. I, II, IV by F.T. Ulaby, R.K. Moore & A.K. Fung, Addision-Wesley Publishing Company, Massachusetts.

4.2 REFERENCE BOOKS:

1. Introduction to the Physics & Techniques of Remote Sensing by Charles Elachi, John Wiley & Sons, New York.
2. Remote Sensing & its Applications by L.R.A. Warayan, University Press (India) Ltd. Hyderabad

5. OUTCOME OF THE COURSE: The student will be able to understand the influence of atmospheric constituent variation on making observation from airborne and satellite borne sensors. It will also develop the understanding about the scatterometer measurement for studying the microwave scattering mechanism with the soil surface and crop/vegetation parameters for their effective monitoring**.**

SEMESTER-VII

NUCLEAR AND PARTICLE PHYSICS

1. GENERAL

1.1 COURSE TITLE: Nuclear and Particle Physics

1.2 *COURSE NUMBER: DC.**PHY401**.15

1.3 CONTACT HRS: 3-0-2, Credit 11

1.4 SEMESTER-OFFERED: Odd

1.5 PRE-REQUISITES: PHY101: Classical Quantum & Relativistic Mechanics, EP-101: Modern Physics, PHY201: Quantum Physics, PHY-301: Atomic & Molecular Physics.

1.6 SYLLABUS COMMITTEE MEMBER: Dr. S. Upadhyay (Convener), Prof. D. Giri, Dr. S. K. Mishra

2. OBJECTIVE

The objective is to introduce students to the fundamental principals, basic concepts of Nuclear and Particle Physics including this applications.

3. COURSE CONTENT

Nuclear Physics: Static properties of Nuclei: Packing fraction and Binding Energy, Spin and Magnetic moments, Schmidt lines, Shape and Electric Quadrupole moments. Liquid drop model and semi empirical mass formula, Shell model and Magic numbers. **(6 lectures)**

Interaction of radiation with matter: Energy loss by charged particles, scattering and passage of electromagnetic radiation through matter; Photoelectric effect, Compton scattering and Pair production. **(4 lectures)**

Nuclear decays: Laws and half-lives, alpha-decay; Gamow theory, alpha spectra and relative intensities; beta-decay: Fermi and Gamow-Teller selection rules, continuous beta spectrum and neutrino, elementary concepts of Fermi theory, Curie plot; gamma-decay: Vibration and rotational excited states and their Spin-Parity, Selection rules and Forbidden transitions, Weisskopf estimates. **(8 lectures)**

Nuclear forces and Nuclear Reactions: Exchange interaction, saturation, non-central and spin-dependent properties; Cross sections, compound nucleus, Resonances and Breit-Wigner formula, Fission. **(5 lectures)**

Neutrons: Sources, slow down, scattering. **(2 lectures)**

Nuclear detection: Geiger counter, Scintillation counter, Solid-state detectors. **(3 lectures)**

Particle Physics: Fundamental Interactions and their relative strengths, Symmetries and

conservation laws in Particle Physics. Leptons, Mesons, Baryons. Strangeness and Hyperons; Particles mediating interactions: photons, W-Z and gluons. Classification with respect to types (Fermions / Bosons), masses and generations. **(3 lectures)**

Eight-fold way and Quark Model: Isosipn and SU(2), Gell-Mann's eight-fold way and SU(3) meson octet, SU(3) baryon octet and decuplet, Quark model: quark bound states, mesons and baryons, masses and Gell-Mann Okubo formula. **(5 lectures)**

Elementary ideas of unification: Standard Model. **(2 lectures)**

4. READINGS

4.1 TEXTBOOK

1. K. S. Krane, Introductory Nuclear Physics, John Wiley, 1987
2. D. Griffiths, "Introduction to Elementary Particles", John Wiley and Sons 2008.
3. D. H. Perkins, Introduction to High Energy Physics, Cambridge University Press, 2000.

4.2 *REFERENCE BOOKS

1. Frank Close, Particle Physics: A very Short Introduction, Oxford University Press, 2004.
2. E. Fermi, Nuclear Physics, University of Chicago Press, 1950.
3. J. M. Blatt and V. F. Weisskopf , Theoretical Nuclear Physics, Dover, 1991.
4. N. A. Jelley, Fundamentals of Nuclear Physics, Cambridge University Press, 2007.
5. F. Halzen and A. D. Martin, Quarks and Leptons: An introductory course in Modern Particle Physics, John Wiley & sons Inc.

5. OUTCOME OF THE COURSE

After completing this course the students will have an understanding about the subatomic world. The students will be aware of elementary particles and interactions between them. This course will set a basis for any higher study in Nuclear and high energy physics.

QUANTUM ELECTRONICS

1. GENERAL

1.1 COURSE TITLE: Quantum Electronics

1.2 *COURSE NUMBER: DC.**PHY402**.15

1.3 CONTACT HRS: 2-0-0, Credit 6

1.4 SEMESTER-OFFERED: Odd

1.5 PREREQUISITE: PHY-101: Classical Quantum & Relativistic Mechanics, PHY-201: Quantum Physics.

1.6 SYLLABUS COMMITTEE MEMBER: Prof. D. Giri (Convener), Dr. S. K. Singh

2. OBJECTIVE

Main aim of this course is to study the Light-Matter Interaction and the physics of quantum devices *e.g.* LASERS, optical detectors, receivers etc.

3. COURSE CONTENT

- Interaction of light and matter, Transition probability; Two level system: Rabi Oscillations. **(3 Lectures)**
- Absorption, stimulated, and spontaneous emission; Quantization of electromagnetic radiation. **(4 Lectures)**
- Raman photon scattering. **(2 Lectures)**
- Lasers, Population inversion, Amplification. **(4 Lectures)**
- Various types of Lasers with example: gas Lasers, solid state lasers, semi-conductor lasers, Free Electron laser. **(6 Lectures)**
- Threshold requirement; Steady state power output; Q-Switching; Mode-locking. **(4 Lectures)**
- Basic concepts of Optical detectors and receivers. **(3 Lectures)**

4. READINGS

4.1 TEXTBOOK

1. Quantum Electronics by A.Yariv, John-Willey.
2. Optical Electronics by A. K. Ghatak, Cambridge University Press.
3. Laser Fundamentals by William T. Silfvast, Cambridge University Press.

5. OUTCOME OF THE COURSE

Student will be able to understand the concept of Light Matter Interaction on the transitions from different levels. By means of different quantum devices.

VII- SEMESTER ELECTIVE / STREAM COURSES (DE-3)

INTRODUCTION TO QUANTUM FIELD THEORY

1. GENERAL

1.1 COURSE TITLE: Introduction to Quantum Field Theory

1.2 COURSE NUMBER: DE.**PHY403**.15

1.3 CONTACT HRS: 3-0-0, Credit 9

1.4 SEMESTER-OFFERED: Odd

1.5 PRE-REQUISITE: PHY-101: Classical, Quantum & Relativistic Mechanics, PHY-201: Quantum Physics

1.6 SYLLABUS COMMITTEE MEMBER: Dr. S. K. Mishra (Convener), Prof. S. Chatterjee, Prof. D. Giri, Dr. P. Dutta

2. OBJECTIVE

Objective of this course is to make the students familiar with the basic program of the quantum field theory with some applications to real physical systems.

3. COURSE CONTENT

1. Brief overview of classical field theory, Noither theorem and symmetries, special relativity and quantum mechanics. **(4 Lectures)**
2. Need for quantum field theory, canonical quantization of free scalar field, creation and annihilation operators, ground state and normal ordering, Concept of propagator. **(8 Lecture)**

3. Scalar field with interactions, phi^4 theory, evolution operator and interaction picture, S matrix, Wicks expansion and Feynman diagram for phi^4 theory. **(5 Lectures)**
4. Calculation the amplitude of different Feynman diagram, examples of matrix element calculations with scalar fields. **(4 Lectures)**
5. Diagrammatic and divergence of a diagram, dimensional regularization with phi^4 theory. **(6 Lectures)**
6. Complex scalar fields, scalar Yukawa theory, prediction of pi-meson. **(3 Lectures)**
7. Spontaneous Symmetry Breaking and examples. **(2 Lectures)**
8. Dirac equation and Spinors, Dirac field quantization, Introduction to QED Lagrangian, propagators and tree level calculation of Compton scattering. **(7 Lectures)**

4. READINGS

4.1 TEXT BOOK

1. An Introduction to Quantum Field Theory by M. E. Peskin and D. V. Schroeder, Levant Books, First Indian Ed. (2005)
2. Lectures on Quantum Field Theory by Ashoke Das, World Scientific, (2008).

4.2 REFERENCES BOOKS

1. A First Book of Quantum Field Theory by A. Lahiri and P.B. Pal, Narosa Publishing house (2001)
2. Quantum Field Theory in a Nutshell by A. Zee, Princeton University Press, (2003) 2nd Edition

5. OUTCOME OF THE COURSE

It is expected that the students would learn the basic formulation of the quantum field theories and would be able to approach problems in condensed matter systems as well as particle physics with the basic knowledge acquired in this course.

MAGNETOHYDRODYNAMICS

1. GENERAL

1.1 COURSE TITLE: Magnetohydrodynamics

1.2 *COURSE NUMBER: DE.**PHY411**.15

1.3 CONTACT HRS: 3-0-0, Credit 9

1.4 SEMESTER-OFFERED: Odd

1.5 PRE-REQUISITES: The 99 % of the fluids in universe is in plasma state. The magnetohydrodynamic (MHD) theory is a tool to constrain the state and dynamics of the magnetized fluids present at diverse spatio-temporal scales.

1.6 SYLLABUS COMMITTEE MEMBER: Dr. A. K. Srivastava (Convener), Dr. A. Mohan, Prof. B. N. Dwivedi

2. OBJECTIVE

The objective of the course is to introduce about the governing MHD equations to describe the state of the single fluid system; magnetostatic conditions; evolved natural forces & their cosequences, wave dynamics, reconnection, and shock processes.

3. COURSE CONTENT

- Electromagnetic equations. Maxwll's equations. **(01 Lecture)**

- Ohm's Law, General ized Ohm's law, Induction equations, Consequences of the induction equations, Diffusive limit, Perfectly conducting limit, Electric conductivity, Dimensionless parameters. **(03 Lectures)**
- Plasma equations, Mass continuity, Equation of motion, Perfect gas law, Energy equations, Different forms of the heat equations, Thermal conduction, Radiation, heating, Energetic. **(05 Lectures)**
- Lorentz force, Magnetic flux tube behavior, current sheet behavior. Magnetohydrostatics: Current-free anti force-free fields, plasma structure in a prescribed magnetic field, structure of magnetic flux tubes (cylindrically symmetric), magnetohydrostatics fields. **(06 Lectures)**
- Magnetic reconnection; MHD waves; shock waves; instabilities; Characteristics in MHD **(10 Lectures)**.
- Numerical and Analytical methods and application of MHD systems. **(05 Lectures)**

4. READINGS

4.1TEXTBOOK

1. Solar MHD by Priest, E.R., Reidel, Dordrecht, Netherlands.
2. Physics of fluids and plasmas by Choudhari, A.R., Cambridge University Press, UK
3. Introduction to plasma physics and controlled fusion by Chen, F.F, Vol. 1, IInd edition. Plenum Press.

5. OUTCOME OF THE COURSE

The course provides basic elementary level knowledge of the MHD, therefore, a student can pursue its applications and more advanced study at higher level in high energy physics, fusion technology, lab plasma experiments, astrophysics, atmospheric science, plasma physics, energy studies, and many more such field.

ADVANCED MATERIALS & CHARACTERIZATION TECHNIQUES

1. GENERAL

1.1 COURSE TITLE: Advanced Materials & Characterization Techniques

1.2 *COURSE NUMBER: DE.**EP421**.15

1.3 CONTACT HRS: 3-0-2, Credit 11

1.4 SEMESTER-OFFERED: Odd

1.5 PRE-REQUISITES: Solid State Physics

1.6 SYLLABUS COMMITTEE MEMBER: Prof. P. Singh (C), Dr. S. Tripathi, Dr. S. Upadhyay

2. OBJECTIVE

This course aims to introduce various characterization techniques to stuy the material properties and morphology.

3. COURSE TOPICS

UNIT-I: Structure and Morphology analysis tools: Fundamental of material characterization using XRD. Atomic scattering and Geometrical structure factors. Factors influencing the intensities of diffracted beams. Rietveld refinement (Quantitative phase analysis and

Qualitative analysis). Applications of XRD. Small angle X-ray scattering (SAXS) to study shape and size distributions. Wide angle X-ray scattering **(15 Lectures)**

UNIT-II: Study of the morphology, aggregation, size and microstructure of materials using Electron microscope: Principle of electron microscopy. Construction and operation of Transmission Electron Microscope and Scanning Electron Microscope. Electron diffraction by crystalline solids; selected area diffraction. Mechanism of image formation in SEM and its processing. Energy dispersive X-ray microanalysis (EDS), Electron microprobe analysis (EDAX and WDS) **(14 Lectures)**

UNIT-III: Thermal Analysis Techniques: Differential Thermal analysis (DTA), Thermo-gravimetric Analysis (TGA) and Differential Scanning Calorimetry (DSC) with suitable examples. **(10 Lectures)**

4. READINGS

4.1TEXTBOOK

1. Elements of X Ray Diffraction,B. D.Cullity, Addison-Wesley Publishing Company, Inc.
2. Transmission Electron Microscopy of Materials,Gareth Thomos, Michael J. Goringe, John Wiley & Sons.
3. The Rietveld method, R.A. Young, International Union of Crystallography, Oxford, New York (1996).
4. Scanning Electron Microscopy and X-ray Microanalysis Joseph Goldstein , Dale E. Newbury, David C. Joy, Charles E. Lyman, Patrick Echlin, Eric Lifshin, Linda Sawyer, J.R. Michael, Springer Science (2003).
5. S. Zhang, L. Li and Ashok Kumar, Materials Characterization Techniques, CRC Press (2008).
6. Eric Lifshin (Ed.), Characterization of Materials (Materials Science and Technology: A Comprehensive treatment), VCH (1992).

4.2 *REFERENCE BOOKS

5. OUTCOME OF THE COURSE

Students are expected to learn fundamentals of a fe materials characterization techniques and implement their knowledge in investigating the materials properties.

INTEGRATED OPTICS

1. GENERAL

1.1 COURSE TITLE: Integrated Optics

1.2 *COURSE NUMBER: DE.**EP431**.15

1.3 CONTACT HRS: 3-0-0, Credit 9

1.4 SEMESTER-OFFERED: Odd

1.5 PRE-REQUISITES: Fiber Optics

1.6 SYLLABUS COMMITTEE MEMBER: Dr. P. C. Pandey (C), Prof. O. N. Singh, Dr. U. N. Singh

2. OBJECTIVE:

The aim of this course is to give a detail study of advanced optical fiber, Non linear effect in optical fibers, electro-optic and acousto-optic effect in different optical fibers. Moreover, this course deals with the different integrated devices.

3. COURSE TOPICS:

- Ray analysis of symmetric and asymmetric planer waveguide, Modes in an asymmetric planer waveguides, **(3 Lectures)**
- Inhomogeneous planer waveguide , W. K. B. Analysis of inhomogeneous planer waveguide **(3 Lectures)**
- Rectangular core waveguides metal clad waveguides , strip waveguides, mode analysis for some specific strip waveguides **(4 Lectures)**
- Leaky modes in a symmetric and asymmetric planer waveguide, Metal clad polarizer, Anisotropic polarizer **(4 Lectures)**
- Non-liner effect in optical fibers, Second harmonic generation (SHG), Cerenkov configuration SHG **(6 Lectures)**
- Electro-optic effect and Acousto-optic effect, phase modulator, polarization modulators and wavelength filters. **(8 Lectures)**
- Integrated Optic devices: The Mach Zhender Interferometric modulator, logic operations, optical directional coupler **(8 Lectures)**

4. READINGS

4.1 TEXTBOOK:

1. J. M. Senior, Optical Fiber Communication, Prentice Hall (1999).
2. Optical Wave guide Theory by Snyder, A.W. and Love, J.D., Chapmann and Hall
3. A.K.Ghatak, Optical Electronics, Cambridge University Press.

4.2 *REFERENCE BOOKS:

1. A. Yariv, Optical Electronics
2. John A. Buck, Fundamentals of Optical Fibers, Wiley Interscience, (2004).

5. OUTCOME OF THE COURSE:

After completing this course the students will be able to understand about the physics involved in advanced optical fiber, Non linear effect in optical fibers, electro-optic and acousto-optic effect in different optical fibers and different integrated devices.

NON-CONVENTIONAL ENERGY SOURCES

1. GENERAL

1.1 COURSE TITLE: Non-Conventional Energy Sources

1.2 *COURSE NUMBER: DE.**EP451**.15

1.3 CONTACT HRS: 3-0-0, Credit 9

1.4 SEMESTER-OFFERED: Odd

1.5 PRE-REQUISITES: Introduction to renewable energy sources

1.6 SYLLABUS COMMITTEE MEMBER: Prof. P. Singh (Convener), Dr. N. Agnihotri

2. OBJECTIVE

This course aims to introduce non-conventional energy sources, specifically, harvesting solar energy for photovoltaic and thermal applications.

3. COURSE TOPICS

Introduction to non-conventional energy sources, Need to Harvest solar energy, Photovolatic cells modules, arrays & costs, Solar cell Technologies: Thin film solar cells, Crystalline silicon solar cells, Multijunction or Tandem cells, Organic solar cells, Hybrid solar cells: Dye sensitized and perovskite solar cells. **(18 Lectures)**

Advanced Solar collectors, Solar concentrators, Solar water heating, Solar thermal power generation **(8 Lectures)**

Advanced energy conversion systems: Power plant, Battery vechiles, Algal biofuels, Metal Hydrates **(5 Lectures)**

Advanced energy storage systems: Hydrogen power, Fuel cells **(5 Lectures)**

4. READINGS

4.1TEXTBOOK

1. Principles of Solar Engineering: F. Kreith, J. F. Kreider, McGraw Hill.
2. Solar cells-Operating principles, technology & system applications: M. A. Green, Prentice Hall Inc.
3. Advanced Energy Systems: V. N. Khartekenko, Taylor & francis 1988.
4. Solar Energy of Thermal Processes: J.A. Duffie, W.A. Beckman, John Willey & Sons. Inc. 1991.

4.2 *REFERENCE BOOKS

1. Solar Energy-Fundamentals and Applications: H.P. Garg & J. Prakash, Tata Mcgraw Hill
2. Photovoltaic Systems Engineering: R. A. Messenger, J.Venture, CRC Press, 2000.

5. OUTCOME OF THE COURSE

Students are expected to learn the science and technology of the various non conventional energy sources.

VIII- SEMESTER ELECTIVE / STREAM COURSES (DE-4, DE-5)

PHASE TRANSITION & CRITICAL PHENOMENA

1. GENERAL

1.1 COURSE TITLE: Phase Transition & Critical Phenomena

1.2 *COURSE NUMBER: DE.**PHY404**.15

1.3 CONTACT HRS: 3-0-0, Credit 9

1.4 SEMESTER-OFFERED: Even

1.5 PRE-REQUISITES: Statistical Physics

1.6 SYLLABUS COMMITTEE MEMBER: Prof. D. Giri (Convener), Dr. S. K. Mishra, Dr. (Mrs.). S. Mishra

2. OBJECTIVE

The aim of the course is to introduce the students the concepts of critical points, symmetry breaking, scaling and renormalization. Also students will learn several analytical and numerical methods of modern statistical mechanics (*e.g.* mean field theory, RG techniques etc.)

3. COURSE CONTENT

- Basic concepts in phase transitions, classical and quantum critical phenomena. **(3 lectures)**
- Phenomenology of 1st order phase transitions, continuous transitions, order parameters and models – Ising, XY, Heisenberg. **(8 lectures)**
- Universality and scaling, Ginzburg-Landau Wilson theory, spontaneous symmetry breaking, ergodicty breaking, critical behavior. **(10 lectures)**
- Critical exponents, relations between critical exponents, Kadanoff scaling, universality conjecture, calculation of critical exponents. **(10 lectures)**
- Real space Renormalization Group (RSRG) methods, φ 4 theory. **(5 lectures)**
- Basic concept of quantum Phase transitions. **(3 lectures)**

4. READINGS

4.1TEXTBOOK

1. Statistical Mechanics by K. Huang, John Wiley & Sons (New York).
2. Introduction to Phase Transitions and Critical Phenomena by H. Eugene Stanley, Oxford Univ. Press, USA.
3. A Modern Approach to Critical Phenomena by Igor Herbut Statistical Physics: Statics, Dynamics and Renormalization by Leo P. Kadanoff

4.3 *REFERENCE BOOKS

1. The Theory of Critical Phenomena by J.J. Binney, A.J. Fisher, M.E.J. Newman
2. Modern Theory of Critical Phenomena by Shang-keng Ma
3. Statistical Mechanics of Phase Transitions by J. Yeomans
4. Field Theory, the Renormalization Group and Critical Phenomena by Daniel J. Amit
5. Phase transition, critical phenomena and Renormalization group by N. Goldenfeld.

5. OUTCOME OF THE COURSE

Students will acquire knowledge and ideas of the modern theory of critical phenomena which are required to solve several problems in statistical mechanics.

PHYSICS OF THE SUN AND ITS ATMOSPHERE

1. GENERAL

1.1 COURSE TITLE: Physics of the Sun and its Atmosphere

1.2 COURSE NUMBER: DE**.PHY 412.**15

1.3 CONTACT HRS: 3-0-0, Credit 9

1.4 SEMESTER-OFFERED: even

1.5 PRE-REQUISITE: NIL

1.6 SYLLABUS COMMITTEE MEMBER: Prof. B.N. Dwivedi (C), Dr. Anita Mohan, Dr. A.K. Srivastava

2. OBJECTIVE

In-depth knowledge of the Physics of the Sun and its Atmosphere.

3. COURSE CONTENT

- Solar observations from the Sun worship to space age: An overview. **(4 Lectures)**
- The Sun's interior. **(4 Lectures)**
- The Sun's photosphere. **(4 Lectures)**
- The Sun's chromosphere. **(4 Lectures)**
- The Sun's corona. **(4 Lectures)**
- The active Sun. **(4 Lectures)**
- The Sun and the solar system. **(4 Lectures)**
- The Sun and other stars. **(4 Lectures)**
- The solar energy. **(4 Lectures)**

4. READINGS

4.1 TEXTBOOK:

1. Guide to the Sun, KJP Phillips, Cambridge University Press.

4.2 REFERENCE BOOKS:

1. Dynamic Sun, BN Dwivedi (ed.), Cambridge University Press (2003, 2007)
2. Physics of the Sun and its Atmosphere, BN Dwivedi & U. Narain (eds.), World Scientific (2008).

5. OUTCOME OF THE COURSE:

Understanding of the Physics of the Sun and its Atmosphere to pursue research in Solar Physics & Astrophysics.

ADVANCED CONDENSED MATTER PHYSICS

1. GENERAL

1.1 COURSE TITLE: Advanced Condensed Matter Physics

1.2 *COURSE NUMBER: DE.**PHY 421**.15

1.3 CONTACT HRS: 3-0-0, Credit 9

1.4 SEMESTER-OFFERED: Even

1.5 PRE-REQUISITES: EP-221: Condensed Matter Physics

1.6 SYLLABUS COMMITTEE MEMBER: Prof. S. Chatterjee (C), Prof. P. Singh, Dr. S. Patil, Dr. S. K. Mishra

2. OBJECTIVE

Basic knowledge of the physical properties of condensed phases of matter and to understand the behavior of these phases by using physical laws.

3. COURSE TOPICS

1. **Structure of solids:** Introduction, Common crystal structures, close-packed structure, Zinc blende and Wurtzite structure, Spinel structure; Intensity of scattered X-ray, Friedel's law; Atomic and geometric structure factors; systematic absences; Electron and neutron scattering by crystals. **(5 Lectures)**
2. **Band theory of solids:** Introduction, Band structures in Copper, GaAs, Silicon and Graphene; Topology of Fermi-surface; Quantization of orbits in a magnetic field, de Haas-van Alphen effect; Boltzmann transport equation -relaxation time approximation, Sommerfeld theory of electrical conductivity. **(5 Lectures)**
3. **Magnetic properties of solids:** Absence of magnetism in classical statistics; Origin of the exchange interaction; Direct exchange, superexchange, and double exchange; DM interactions, RKKY interactions, Heisemberg and Ising models; Spin-waves in ferromagnets and antiferromagnets (semi classical and quantum treatment using Holstein Primakoff transformation), spontaneous symmetry breaking in magnetic systems with continuous symmetry, thermodynamics of magnons, mean field theory and critical behaviour for large S models. **(8 Lectures)**
4. **Superconductivity:** Electron-electron interaction via lattice: Cooper pairs; BCS theory; Type II superconductors— characteristic length; Giaver tunnelling; Flux quantisation; a.c. and d.c. Josephson effect; "Novel High Temperature" superconductors. **(5 Lectures)**
5. **Disordered systems**: Disorder in condensed matter — substitutional, positional and topographical disorder; Short- and long-range order; Atomic correlation function and structural descriptions of glasses and liquids; Anderson model; mobility edge; Minimum Metallic Conductivity, Qualitative application of the idea to amorphous semiconductors and hopping conduction. Percolation phenomena and the associated phase transition properties. **(10 Lectures)**
6. **Important topics:** Mott transition, Stoners criterion for metallic ferromagnet. Elementary introduction to Hubbard Model, Kondo effect. **(6 Lectures)**

4. READINGS

4.1TEXTBOOK

1. Solid State Physics, N.W. Ashcroft and N.D. Mermin, Harcourt College Publishers.
2. Fundamentals of Solid State Physics, J.R. Christman, Wiley Edition.
3. Solid State Physics, A.J. Dekker, Macmillan & Co. Ltd.
4. Introduction to Solid State Physics, C. Kittel, Wiley Edition.
5. Solid State Physics: An Introduction to Theory and Experiment, H. Ibach and H. Luth, Springer
6. Elements of Solid State Physics, J.P. Srivastava, Prentice Hall of India.

4.2 *REFERENCE BOOKS

1. Solid State and Semiconductor Physics, J.P. McKelvey, Krieger Publishing Campus.
2. Introduction to Solid State Theory, O. Madelung, Springer

3. Collective Effects in Solids and Liquids, N.H. March and M. Parrinello, Adam Hilger Ltd.
4. Principles of the Theory of Solids, J.M. Ziman, Cambridge Univ. Press.
5. Quantum Theory of Soli, C. Kittel, Wiley Edition.

5. OUTCOME OF THE COURSE

Students will have clear idea regarding structure, electrical and magnetic properties of materials.

PHOTONICS & OPTOELECTRONICS

1. GENERAL

1.1 COURSE TITLE: Photonics and Optoelectronics

1.2 *COURSE NUMBER: DE.**EP432**.15

1.3 CONTACT HRS: 3-0-0, Credit 9

1.4 SEMESTER-OFFERED: Even

1.5 PRE-REQUISITES: Integrated Optics

1.6 SYLLABUS COMMITTEE MEMBER: Dr. P. C. Pandey (C), Prof. O. N. Singh, Dr. S. K. Singh

2. OBJECTIVE

The objective of this course is to give a detail study of sources, detectors and receivers used for optical fiber technology. Moreover, it also covers an advance application of optical fiber as sensor.

3. COURSE CONTENT

Semiconductor lasers for optical fiber communications, Fabry-Perot cavity, hetero-structure semiconductor lasers, laser modes and single frequency semiconductor lasers- strip geometry, distributed feedback (DFB) and distributed Bragg reflectors (DBR), laser characteristics and efficiency, quantum-dot lasers, non-semiconductor lasers for optical fiber communications, laser to fiber coupling. **(16 Lectures)**

Photo-detectors for fiber optics, reverse bias photo-detectors, dark current, quantum efficiency and responsivity, signal to notice ratio, types of detectors- *p–i–n* photodiode, avalanche photodiodes (APDs), quantum-dot photo-detectors, phototransistors. **(10 Lectures)**

Receivers for digital fiber optic communication system, FET preamplifiers, PIN-FET receivers for longer wavelength communication systems. **(6 Lectures)**

Optical fiber sensor and devices, intensity modulation through light interruption, distributed sensing with fiber optics. Basic principles of interferometric optical fiber sensor, signal processing in mono mode fiber optic sensor. **(7 Lectures)**

4. READINGS

4.1 TEXTBOOK::

1. J. M. Senior, Optical Fiber Communication, Prentice Hall (1999).
2. G. Keiser, Optical Fiber Communications, McGraw Hill (2000).
3. A.K.Ghatak, Optical Electronics, Cambridge University Press.

4.2 *REFERENCE BOOKS:

1. K. Okamoto, Fundamentals of Optical Waveguides, Academic Press, (2000).
2. John A. Buck, Fundamentals of Optical Fibers, Wiley Interscience, (2004).

5. OUTCOME OF THE COURSE:

After completing this course the students will be able to understand about the source and detection in optical fiber technology. Students will also be able to apply the knowledge in area of optical sensing devices.

ADVANCED BIOPHYSICS

1. GENERAL

1.1 COURSE TITLE: Advanced Biophysics

1.2 *COURSE NUMBER: DE.**EP441**.15

1.3 CONTACT HRS: 3-0-0, Credit 9

1.4 SEMESTER-OFFERED: Even

1.5 PRE-REQUISITES: NO

1.6 SYLLABUS COMMITTEE MEMBER: Dr. A.S. Parmar (C), Prof. D. Giri, Dr. S. Mishra

2. OBJECTIVE

The Advanced Biophysics course is intended for advanced students. It builds on the material covered in the Introduction to Biophysics course, but completion of the latter is not required to enroll into this course. The student will obtain an understanding of the physical principles underlying the many facets of modern biological physics.

3. COURSE CONTENT

I. Biological Soft Condensed Matter (12 Lectures)

a. Biological Polymers
b. Supramolecular Self-assembly
c. Biocolloids
d. Molecular Order and Soft Materials

II. Protein Folding, Unfolding, and Misfolding (12 Lectures)

a. Introduction to Protein Architecture
b. Cooperative Transitions in Protein Molecules
c. Kinetics of Protein Folding and the Energy Landscape Model
d. Introduction of Protein Misfolding and Aggregation
e. Misfolding and Human Diseases

III. Analysis of Structures (8 Lectures)

a. Databases and Homology Modelling
b. Energy Minimization, Poses & Docking
c. Electrostatics – Potentials & Pks
d. Molecular Dynamics

IV. Life in Low Reynolds-number World (7 Lectures)

a. Friction in Liquid (Role of Viscosity)

b. Low Reynolds Number

c. Biological Applications of Low Reynolds Number.

4. READINGS

4.1TEXTBOOK

1. Soft Condensed Matter Physics in Molecular and Cell Biology by W.C.K. Poon, David Andelman (2006), Taylor & Francis, ISBN 9780750310239 - CAT# IP658
2. Principles of Physical Biochemistry (2nd Ed.) by van Holde, K.E., Johnon, C. & Ho, P.S. (2006) Prentice Hall, ISBN-10: 0130464279 / ISBN-13: 9780130464279

4.2 *REFERENCE BOOKS

1. Protein Folding (1st Ed.) by Thomas E. Creighton, ISBN-13: 978-0716770275
2. Mechanism of Protein Folding (2nd Ed.) by R.H. Pain ISBN-13: 978-0199637881

5. OUTCOME OF THE COURSE

It will provide in-depth knowledge of molecular and cellular biology. It will also prepare students to carry out research in field of Biophysics, Biotechnology, Biomedical and Bio-nanotechnology.

FUEL CELL

1. GENERAL

1.1 COURSE TITLE: Fuel Cell

1.2 *COURSE NUMBER: DE.**EP452**.15

1.3 CONTACT HRS: 3-0-0, Credit 9

1.4 SEMESTER-OFFERED: Even

1.5 PRE-REQUISITES:

1.6 SYLLABUS COMMITTEE MEMBER: Prof. P. Singh (Convener), Dr. N. Agnihotri

2. OBJECTIVE

This course aims to introduce Fuel cells as an alternative energy sources. The course introduces, fundamentals of the fuel cells and its applications.

3. COURSE TOPICS

Unit cell and characteristics of a fuel cell, types of fuel cells, Fuel cell performance, Thermodynamics of fuel cells, energy balance and importance of Gibbs free energy and nerst potential **(9 Lectures)**.

Heat and mass transfer in fuel cell, diffusion coefficient, charge and water transport in fuel cells, Ohmic loss, **(8 Lectures)**

Characterization of Fuel cell and its components, electrochemical characterization, electronic, ionic and mixed conductivity of the components of fuel cell **(9 Lectures)**

Polymer electrolyte fuel cells, alkaline fuel cells, phosphoric acid fuel cells, molten carbonate fuel cells, Solid oxide fuel cells **(11 Lectures)**

4. READINGS

4.1TEXTBOOK

1. Handbook of fuel cells, Funfamentals technology and applications ISBN: 780470974001.
2. Fuel cells from fundamentals to applications, Supramaniam Srinivasan, Springer, ISBN-13: 978-1441937728
3. Fuel Cell handbook, 17th Edition By EG & G technical services, Inc.

4.2 *REFERENCE BOOKS

5. OUTCOME OF THE COURSE

Students are expected to learn fundamentals Fuel cells and their technological applications

ANTENNA & RADAR ENGINEERING

1. GENERAL

1.1 COURSE TITLE: Antenna & Radar Engineering

1.2 COURSE NUMBER: DE.**EP461**.15

1.3 CONTACT HRS: 3-0-0, Credit 9

1.4 SEMESTER-OFFERED: Even

1.5 PRE-REQUISITE: Basic course on Electromagnetics

1.6 SYLLABUS COMMITTEE MEMBER: Prof. R. Prasad (convener), Prof. P. Singh

2. OBJECTIVE

Its objective is to provide an understanding of the basic concepts, operation, and applications of antenna and modern radar systems. It is designed to develop the knowledge and techniques necessary to analyze the performance of radar systems.

3. COURSE CONTENT

Unit I: Fundamental Parameters of Antennas

Radiation pattern, isotropic, directional and omnidirectional patterns, filed regions, radiation power density, radiation intensity, beamwidth, directivity, directional pattern, antenna efficiency, gain, beam efficiency, polarization, maximum directivity and maximum effective area, Friis transmission equation. **(10 Lectures)**

Unit II: Introduction to Radar

Introduction to radar systems, radar frequencies, prediction of range performance, minimum detectable signal, signal to noise ratio, radar cross section of targets. **(10 Lectures)**

Unit III Radar Calibration

Passive calibration targets, flat rectangular plate, flat circular plate, sphere, corner reflector, active radar calibration, polarimetric active radar calibration. **(7 Lectures)**

Unit IV: Radar Systems

Doppler effect, CW radar, frequency modulated CW radar, Moving target indication radar, pulsed Doppler radar, tracking with radar, sequential lobbing, conical scan, target reflection characteristics and angular accuracy, tracking in range, tracking in Doppler. **(12 Lectures)**

4. READINGS

4.1 TEXTBOOK:

1. Microwave Radar and Radiometric Remote Sensing, Ulaby, F.; Long, D.; Blackwell, W.; Elachi, C. & Sarabandi, K., University of Michigan Press,, University of Michigan Press, 2014.
2. Introduction to radar systems, Merrill I. Skolnik, McGraw-Hill Book Company, Inc., USA.

4.2 REFERENCE BOOKS:

1. Techniques of Radar Reflectivity Measurement, Nicholas C. Currie, Artech House Inc., 610 Washington St., Dedham, MA 02026.
2. Radar Reflectivity: Techniques and Applications by Nicholas C. Currie, Artech House Inc., 610 Washington St., Dedham, MA 02026.
3. Antenna Engineering By John Kraus, Tata McGraw-Hill Education.

5. OUTCOME OF THE COURSE

The student will be able to specify the subsystem performance requirements in a radar system design for various applications.

IX- SEMESTER ELECTIVE / STREAM COURSES (DE-6, DE-7)

SIMULATION METHODS IN STATISTICAL PHYSICS

1. GENERAL

1.1 COURSE TITLE: Simulation Methods in Statistical Physics

1.2 *COURSE NUMBER: DE.**PHY501**.15

1.3 CONTACT HRS: 3-0-0, Credit 9

1.4 SEMESTER-OFFERED: Odd

1.5 PRE-REQUISITES: Statistical Physics, Basics Computer programming

1.6 SYLLABUS COMMITTEE MEMBER: Prof. D. Giri (Convener), Dr. S. K. Mishra, Dr. A. K. Srivastava, Dr. (Mrs.). S. Mishra

2. OBJECTIVE

Objective of this course is to provide students a deeper knowledge about the Computer Simulation methods in Statistical Physics.

3. COURSE CONTENT

- Simulations in different ensembles: Monte Carlo and Molecular dynamics method. **(15 Lectures)**
- Markov chain theory: Detailed balance, Metropolis method, Heat bath method, etc, Convergence, Dynamical point of view, simulating rare events using N-fold way. **(8 Lectures)**
- Data analysis: Estimating errors. Autocorrelation times, Histogram reweighting. **(8 Lectures)**
- Advanced Topic: Transfer Matrix, DMRG, Exact Enumeration, Quantum MC etc. **(8 Lectures)**

4. READINGS

4.1TEXTBOOK

1. K. Binder and D.W. Heermann, Monte Carlo Simulation in Statistical Physics. An Introduction (4^{th} edition). Springer. (2002).
2. Understanding Molecular simulations, D. Frenkel and B. Smith, (Academic press, 2002).
3. Computational Physics, J. M. Thijssen, (Cambridge, 2007).

4.2*REFERENCE BOOKS

1. Computational Physics, Rubin H. Landau, Manuel J. Paez, and Cristian C. Bordeianu (Wiley-VCH, Weinheim, 2007).
2. Numerical Recipes, (Cambridge Univ Press.)

5. OUTCOME OF THE COURSE

Students are expected to have a theoretical understanding of Monte Carlo and Molecular dynamics methods along with the implementation of these techniques in different ensembles.

ATMOSPHERICS PHYSICS AND ENVIRONMENTAL SCIENCE

1. GENERAL

1.1 COURSE TITLE: Atmospheric Physics and Environmental Science

1.2 COURSE NUMBER: DE.**EP 511**.15

1.3 CONTACT HRS: 3-0-0 Credit: 9

1.4 SEMESTER-OFFERED: Odd

1.5 PRE-REQUISITE: Basic understanding of Interaction of radiations with matter: Absorption, scattering, reflection, diffusion and emission. Knowledge of Isothermal and Adiabatic gas law.

1.6 SYLLABUS COMMITTEE MEMBER: Dr. A. Mohan (Convener), Prof. B. N. Dwivedi, Dr. A. K. Srivastava

2. OBJECTIVE

The objective is to impart the knowledge of the atmosphere of the Earth: some historical survey of structure and composition of the atmosphere, present form of the atmosphere, and what it will be in coming years. To find the reasons of changing climate. To find the ways to protect the ozone layer from getting depleted. Challenges and solutions of global warming.

3. COURSE CONTENT

- The structure and evolution of the planetary atmospheres and with the wide range of phenomena that occur within them, with a particular focus on the Earth's atmosphere interacting with other components such as the lithosphere, the biosphere, the hydrosphere and the cryosphere. Hydrostatic balance, Density, temperature and pressure profiles of the Earth's atmosphere. **(8 classes)**
- Insolation, Radiative transfer, radiative heating and vertical mixing, Green house gases, their source, sink and importance Heat budget and Earth's energy balance. Atmospheric models: Simple radiative model and green house model. **(8 classes)**
- Chapman mechanism. Catalytic destruction of ozone. Ionosphere, ionization sources and basic theory of Photo-ionization. Airglow and Auroras. **(5 classes)**
- Aspects of physics that pervade environmental processes in our everyday lives and in naturally occurring phenomena that include energy supply and resources issues, which

growing needs and use can impact on environment. Global warming and its impact on climate, environment, human health, wildlife and natural resources. **(6 classes)**

- Global warming solutions- Role of mankind in modifying the environment through Earth resource development. Energy conservation and renewable energy; sustainability, efficiency, alternative fuels, reducing carbon footprint. Purpose of the IPCC. **(8 classes)**

4. READINGS

4.1 TEXTBOOK

1. Atmosphere by Kellogg William and Mead Margaret, Castle House Publications Ltd. 1980.
2. Introduction to ionospheric physics by Rishbeth and Garriot, Academic Press. 1969.
3. Aurora and Airglow by B.McCormac, VN Reinhold Publisher.
4. Geology and the Environment by Pipken, B. W. and D. D. Trent. 4th ed. California, CA: Brooks Cole, 2004.
5. Environmental Geoscience by Thompson, G. R., and J. Turk. 3rd ed. Ft Worth, TX: Harcourt Brace and Company, 1997

4.2 REFERENCE BOOKS

1. Aurora by A. Vallance Jones, D.Reidel Publishing Company, 1974.
2. Aeronomy by P.M. Banks and G. Cockarts, 1973.

5. OUTCOME OF THE COURSE

At the end of the course the students will learn how the earth's atmosphere acts as a shield to enable living organisms survive on this planet and about the mechanisms responsible for the climate change and its impact on the environment. Also they will know how the atmosphere is degraded by anthropogenic impact and what are the solutions to protect it from further degradation.

SPACE WEATHER

1. GENERAL

1.1 COURSE TITLE: Space Weather

1.2 COURSE NUMBER: DE**.EP 511.**15

1.3 CONTACT HRS: 3-0-0, Credit 9

1.4 SEMESTER-OFFERED: Odd

1.5 PRE-REQUISITE: NIL

1.6 SYLLABUS COMMITTEE MEMBER: Prof. B.N. Dwivedi (C), Dr. Anita Mohan, Dr. A.K. Srivastava

2. OBJECTIVE

This course is aimed to make students, and engineers in particular, aware of the solar or spatial origin of the disturbances and disruptions that are witnessed in many ground based and spatial technological systems, and to explain the physical mechanisms behind them, to indicate where to find the relevant predictive data and to train how to interpret them in order to lower the risk of damage to technical equipment and economic losses.

3. COURSE CONTENT

- The whole set of complex effects of the radiation and the plasma stream from the Sun on the Earth and its magnetosphere; technological systems; climate and the people. **(6 Lectures)**
- The explosions that occur frequently on the Sun and especially the magnetic plasma clouds (*coronal mass ejections)*; solar drivers of the space weather. **(6 Lectures)**
- The detectable effects on Earth and its spatial environment in a broad spectrum of time and length scales; various harmful effects for human health and for our technologies. **(6 Lectures)**
- Polar light (aurora) -- space weather effects; bad weather conditions in space; hindrance or damage satellite operations; disruptions of telecommunication and navigation systems and the related geo-magnetic storms inducing peak currents in pipelines; cause of power grid outages -- a variety of tremendous socio-economic losses. **(6 Lectures)**
- Solar flares and their effects **(4 lectures)**
- Radiation risks for the crew and passengers on air planes and astronauts in space; An overview of space weather effects; the physical mechanisms; modeling and prediction. **(6 Lectures)**

4. READINGS

4.1 TEXTBOOK: Handouts, Articles.

4.2 REFERENCE BOOKS:

5. OUTCOME OF THE COURSE:

This course gives an overview of space weather effects and the physical mechanisms behind them and explains how these can be modeled and predicted.

LOW DIMENSIONAL PHYSICS

1. GENERAL

1.1 COURSE TITLE: Low Dimensional Physics

1.2 *COURSE NUMBER: DE.**PHY521**.15

1.3 CONTACT HRS: 3-0-0, Credit 9

1.4 SEMESTER-OFFERED: Odd

1.5 PRE-REQUISITES: Condensed Matter Physics and Advanced Condensed Matter Physics

1.6 SYLLABUS COMMITTEE MEMBER: Prof. S. Chatterjee (Convener), Prof. P. Singh, Dr. S. Tripathi, Dr. S. Patil.

2. OBJECTIVE

Basic knowledge of the low dimensional materials to understand the behavior of these materials in the nano phase by using physical laws.

3. COURSE TOPICS

Introduction, Physics of Low Dimensional materials, idea of 2d,1d and 0d materials; Hetrostructures - Band bending, depletion width and capacitance, inversion layer, 2d electron gas in triangular well; subband, density of states, surface electron density; Exciton, quantum

size effect, electron confinement — strong and weak limit, spherical well, effect of confinement. **(10 Lectures)**

Experimental techniques for characterization of low dimensional materials: Scanning probe microscopy, SEM, TEM, XRD, and light scattering experiments; different methods of preparation of nanomaterials. Top down: UV and electron beam lithography, Ball milling; Bottom up: Atom manipulation by SPM, Dip pen nanolithography, Microcontact printing; Cluster beam evaporation, Ion beam deposition, chemical bath deposition, Self assembled mono layers. **(12 Lectures)**

Ballistic transport, density of states for 1d system; quantized conductance, Landauer formula, conductance behavior of quantum point contact; Landauer Buttiker formula for multileads. Coulomb blockade, Coulomb diamond, single electron transistor (SET), molecular electronics. **(6 Lectures)**

Magnetic field effect on low dimensional materials, The Aharonov–Bohm effect, The Shubnikov–de Haas Effect, Quantum Hall effect. **(5 Lectures)**

Special carbon solids, fullerenes and tubules, formation and characterization of fullerenes and tubules, single wall and multiwall carbon tubules; Electronic properties of tubules; Carbon nanotubule based electronic devices. Graphene. **(6 Lectures)**

4. READINGS

4.1TEXTBOOK

1. C. P. Poole, Jr. and F. J. Owens, Introduction to Nanotechnology (Wiley Edition)
2. Y. Murayama, *Mesoscopic Systems* (Wiley-VCH, Weinheim)
3. J.H. Davies, *The Physics of Low-Dimensional Semiconductors* (Cambridge University Press, Cambridge)
4. S. Luryi & A. Zaslasvsky, *Modern Semiconductor Device Physics*, Ed.Sze, S.M. (Wiley, New York).

4.2*REFERENCE BOOKS

1. J.M. Martínez-Duart, R.J. Martín-Palma, F. Agulló-Rueda, Nanotechnology for Microelectronics and Optoelectronics (Elsevier).
2. Nano: the essentials, T. Pradeep (Tata Mcgraw Hill)
3. A.J. Dekker: Solid State Physics, Macmillan Campus Edition.
4. C. Kittel: Introduction to Solid State Physics, Wiley Edition.

5. OUTCOME OF THE COURSE

Students will learn the mechanism behind the interesting behavior observed in nano-materials and will have idea regarding the application of nano-materials.

PBG & META - MATERIALS

1. GENERAL

1.1 COURSE TITLE: PBG & Meta-materials

1.2 *COURSE NUMBER: DE.**PHY531**.15

1.3 CONTACT HRS: 3-0-0, Credit 9

1.4 SEMESTER-OFFERED: Odd

1.5 PRE-REQUISITES: PHY-102 & Physics of Materials.

1.6 SYLLABUS COMMITTEE MEMBER: Dr. P. C. Pandey (C), Prof. O. N. Singh, Dr. S. K. Singh

2. OBJECTIVE:

The aim of the course is to give a detail study of of Photonic band gap Materials and Metamaterials. These materials are a new class of materials and their applications are very unique in the field of communication and sensor technology.

3. COURSE CONTENT

- Wave propagation in isotropic and anisotropic media, Basics of photonic Band gap materials, Types of Photonic Band Gap Materials. **(4 Lectures)**
- Fabrications techniques of PBG materials **(4 Lectures)**
- Analysis of Photonic band gap materials transfer matrix, plane wave expansion method **(6 Lectures)**
- Optical properties and Band structure of 1D, 2D & 3D Photonic Band Gap Materials. **(4 Lectures)**
- Optical properties and Band structure of PBG materials with Defects, **(2 Lectures)**
- Applications-communication and sensors. **(2 Lectures)**
- Fundamentals of Metamaterials, Optical Properties of Metal-Dielectric Composites. **(4 Lectures)**
- Fabrication of Two-Dimensional Optical Metamaterials. **(2 Lectures)**
- Negative-Index materials, left handed materials and Metamaterials, Nonlinear Optics in Metamaterials, Super Resolution with Meta-Lenses. Other applications of metamaterials.**(8 Lectures)**

4. READINGS

4.1 TEXTBOOK:

1. Photonics by Amnon Yariv and Pochi Yeh, Sixth Edition, Oxford University Press, 2007.
2. Wave propagation from electron to photonic crystals and metamaterials by P. Markos and CM Soukoulis

4.2 *REFERENCE BOOKS:

1. Wave propagation in periodic media by P. Yeh
2. Photonic crystal: Modeling the flow of light by JD Jonapolous et al.

5. OUTCOME OF THE COURSE:

After completing this course, the students will be able to understand about the physics involved in Photonic band gap materials and Metamaterials. Moreover the students will be able to understand about Optical properties of PBG and Meta materials and their applications.

SATELLITE IMAGE PROCESSING

1. GENERAL

1.1 COURSE TITLE: Satellite Image Processing

1.2 COURSE NUMBER: **DE.EP561.15**

1.3 CONTACT HRS: 3-0-0, Credit 9

1.4 SEMESTER-OFFERED: Odd

1.5 PRE-REQUISITE: Introduction to remote sensing, basic knowledge about the digital images and skill for writing computer programming.

1.6 SYLLABUS COMMITTEE MEMBER: Prof. R. Prasad (Convenor), Prof. P. Singh

2. OBJECTIVE

Its objective is to provide the understanding for acquiring information from remote sensing images using different algorithms for classification and monitoring the land use land cover. It can be used for monitoring the natural resources using satellite image processing techniques.

3. COURSE CONTENT

UNIT I: Introduction to satellite images

Introduction to satellite images: pixel, digital number and scale; Characteristics of sensors: types, orbit, swath, altitude, nadir angle, range, azimuth and instantaneous field of view (IFOV); satellite based imaging system: along track and across track scanning, Characteristics of earth resource satellites. **(6 Lectures)**

UNIT II: Characteristics of satellite images

Concept of resolutions in satellite images: spatial, spectral, temporal and radiometric; Elements of visual image interpretation: tone, shape, size, pattern, texture, shadow, and association, Concepts of thermal & microwave remote sensing images, Hyperspectral imaging, Spectral signatures and spectral response patterns. **(8 Lectures)**

UNIT III: Satellite Image pre-processing

Layer stacking, geometric, radiometric and atmospheric corrections, image fusion, image enhancement techniques: contrast stretching, density slicing, band rationing, vegetation indices (VI), filtering and principal component analysis (PCA), image transformations: subtraction, addition, multiplication and division. **(12 Lectures)**

UNIT IV: Satellite Image classification

Optimum bands selection prior to classification, supervised and unsupervised classification and other classification approaches; accuracy assessment; change detection analysis for natural resource studies and management. **(12 Lectures)**

4. READINGS

4.1 TEXTBOOK:

1. Lillesand, T. and Kiefer, R.W., Remote Sensing and Image Interpretation, 5th ed., John Wiley & Sons, Singapore, 2004.
2. Jensen J.R., Remote Sensing Of Environment: An Earth Resource Perspective, Prentice Hall, NJ, 2000.

3. Richards, J.A. and X. Jia, Remote Sensing Satellite Image Analysis, 4th ed., Springer, Berlin, 2006.

4.2 REFERENCE BOOKS:

1. Schowengerdt, R., Remote Sensing: Models and Methods for Image Processing, 3rd ed., Academic Press, Elsevier, NY, 2007.
2. Gonzalez, R.C., and Woods, R.E., Satellite Image Processing, 3rd ed., Prentice-Hall, NJ, 2008.

5. OUTCOME OF THE COURSE:

The students will be able to utilise this skill for the urban planning and management and predicting the reduction of agricultural land in to urban land. They would be able to understand the natural resources management such as agriculture, forestry, and other land cover etc.

Syllabus for other open elective other than departmental core and departmental elective

Electromagnetic Waves

1. GENERAL

1.1 COURSE TITLE: Electromagnetic Waves

1.2 COURSE NUMBER: OE**.EP 301.**16

1.3 CONTACT HRS: 2-0-0, Credit 6

1.4 SEMESTER-OFFERED: Both (Open to all except who have done the PHY-102 course)

1.5 PREREQUISITE: NIL

1.6 SYLLABUS COMMITTEE MEMBER: B.N. Dwivedi (C), Anita Mohan, Abhishek Srivastava

2. OBJECTIVE

Every part of the electromagnetic spectrum has multiple applications in our everyday lives, and many of those applications involve technology. The entire field is shifting towards important applications in high-speed communications and computing as well as biomedicine.

3. COURSE CONTENT

- Physical concepts of gradient, divergence, and curl: Scalar and vector fields; Physical concepts of gradient, divergence and curl; Divergence and Stokes' theorem; Laplacian operator and Helmholtz theorem. **(5 lectures)**
- **Maxwell's equations:** The experimental laws of electricity and magnetism (e.g., Coulomb, Ampère, and Faraday) in terms of their physical contents and mathematical representations; The displacement current --- emergence of new physics; The prediction of the existence of electromagnetic waves; Transport of energy and momentum through empty space by means of electromagnetic fields; Lorentz force. **(7 lectures)**
- **Electromagnetic waves:** The entire electromagnetic spectrum, ranging from X-rays, ultraviolet, visible, infrared, microwaves to radio waves; Electromagnetic wave equations in terms of electric scalar potential and magnetic vector potential, and its physical meaning; Electromagnetic waves and their solutions; Physical insight of magnetic vector potential in terms of electromagnetic momentum per unit charge; Spherical waves from a

point source; Electromagnetic waves in a dielectric medium; The complex refractive index; The energy flow in the electromagnetic field. **(7 lectures)**

- **The motion of charges in electric and magnetic fields:** Motion in a uniform electric or magnetic field; Momentum analysis; An electrostatic lens; A magnetic lens; The electron microscope --- TEM, SEM; Accelerator guide fields; Alternating-gradient focusing; Motion in a crossed electric and magnetic fields. **(7 lectures)**

4. READINGS

4.1 TEXTBOOK:

1. Electromagnetic Waves, Carlo G. Someda, 2006 by CRC Press.

4.2 REFERENCE BOOKS:

1. The Feynman Lectures on Physics, Volume II, (mainly electromagnetism and matter).

5. OUTCOME OF THE COURSE: Maxwell's equations govern the physics of electromagnetic wave phenomena and their accurate solution is essential to understanding all high-speed signal effects, whether electronic or optical. Students who well understand the basis of electromagnetic phenomena are well-equipped to attack a broad spectrum of important problems to advance knowledge in all branches of engineering and technology which directly benefit our society.

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A. List of flexi-core (if any) with the semesters in which they will be offered (odd or even)

B. List of streams

0 : Non Specialization or Non Stream
1 : Solar & Space Plasma Physics
2 : Condensed Matter & Materials Physics
3 : Photonics
4 : Biophysics
5 : Energy Studies
6 : Remote Sensing

C. List of Department Electives (UG/PG) and stream/bouquet electives with the semesters in which they will be offered (odd or even)

V th Semester: (Elective-I) (any ONE)

1. DE.**EP 341**.15 Introduction to Biophysics
2. DE.**EP 351**.15 Introduction to Renewable Energy Sources
3. DE.**EP.361**.15 Introduction to Remote sensing

VI th Semester: (Elective-II) (any ONE)

1. DE.**PHY 305**.15 Advanced Quantum Mechanics
2. DE.**PHY 311**.15 Introduction to Astronomy & Astrophysics
3. DE.**PHY 321**.15 Physics of Materials
4. DE.**EP 331**.15 Advanced Optical fiber & components
5. DE.**EP 342**.15 Biophysical Techniques
6. DE.**EP.362**.15 Microwave remote sensing

VII th Semester: (Elective-III) (any ONE)

1. DE.**PHY 403**.15 Introduction to Quantum Field theory

2. DE.**PHY 411**.15 Magnetohydrodynamics
3. DE.**EP 421**.15 Advanced Materials & Characterization techniques
4. DE.**EP 431**.15 Integrated Optics
5. DE.**EP 451**.15 Non-Conventional Energy sources

VIII th Semester: (Elective-IV & Elective-V) (any TWO)

1. DE.**PHY 403**.15 Phase transition & critical phenomena
2. DE.**PHY 412**.15 Physics of the Sun and its Atmosphere
3. DE.**PHY 421**.15 Advanced Condensed Matter Physics
4. DE.**EP 432**.15 Photonics & Optoelectronics
5. DE.**EP 441**.15 Advanced Biophysics
6. DE.**EP 452**.15 Fuel Cell
7. DE.**EP 461**.15 Antenna & Radar Engineering

IX th Semester: (Elective-VI & Elective -VII) (any TWO)

1. DE.**PHY 501**.15 Simulation Methods in Statistical Physics
2. DE.**EP 511**.15 Atmospheric Physics and Environmental Sciences
3. DE.**EP 512**.15 Space weather
4. DE.**PHY 521**.15 Low dimensional physics
5. DE.**PHY 531**.15 PBG & Meta-materials
6. DE.**EP 561**.15 Satellite Image Processing

D. List of open electives (offered for other departments)

1. For 5th Semester

(a) MC.PHY 201.15 Quantum Physics
(b) DE.EP 341.15 Introduction to Biophysics
(c) OE.EP 301.16 Electromagnetic waves

2. For 6th Semester

(a) DC.PHY21**1**.15 Solar and Space Plasma Physics
(b) DE.PHY 321.15 Physics of Materials

3. For other semesters: List of other electives will be declared later