M. Sc. (Physics) Programme

SYLLABI

(Semester – 1)

CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY

CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY Date : 29/06/2019

P. D. PATEL INSTITUTE OF APPLIED SCIENCES
MASTER OF SCIENCE

Syllabus Details

Effective Year 2019-20

Degree : M.Sc. (PHY) **Semester** : 1
Total Subjects : 9
Total Regular Subjects : 6
Total Elective Subjects : 3

Group Name : UNI. ELECTIVE-I

Course Code	Course Title	Teaching Scheme					Examination Scheme						
		CREDIT				TOTAL HOURS	TH		PR		PRJ		TOTAL
		TH	PR	PRJ	TOTAL		Internal	External	Internal	External	Internal	External	
MA771.01	RELIABILITY AND RISK ANALYSIS		2.00		2.00	2.00	-	-	0/30	28/70	-	-	100
EE781.01	OPTIMIZATION TECHNIQUES		2.00		2.00	2.00	-	-	0/30	28/70	-	-	100
ME781.01	OCCUPATIONAL HEALTH & SAFETY		2.00		2.00	2.00	-	-	0/30	28/70	-	-	100
CE772.01	RESEARCH METHODOLOGY		2.00		2.00	2.00	-	-	0/30	28/70	-	-	100
CA730	INTERNET AND WEB DESIGNING		2.00		2.00	2.00	-	-	0/30	28/70	-	-	100
PT795.01	HEALTH & PHYSICAL ACTIVITY		2.00		2.00	2.00	-	-	0/30	28/70	-	-	100
NR755	FIRST AID & LIFE SUPPORT		2.00		2.00	2.00	-	-	0/30	28/70	-	-	100
RD701.01	INTRODUCTION TO ANALYTICAL TECHNIQUES		2.00		2.00	2.00	-	-	0/30	28/70	-	-	100
RD702.01	INTRODUCTION TO NANOSCIENCE AND TECHNOLOGY		2.00		2.00	2.00	-	-	0/30	28/70	-	-	100
MB650	CREATIVE LEADERSHIP		2.00		2.00	2.00	-	-	0/30	28/70	-	-	100
PH891	COMMUNITY PHARMACY OWNERSHIP		2.00		2.00	2.00	-	-	0/30	28/70	-	-	100
PD261	ASTROPHYSICS, SPACE AND COSMOS-I		2.00		2.00	2.00	-	-	0/30	28/70	-	-	100

CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY Date : 29/06/2019

P. D. PATEL INSTITUTE OF APPLIED SCIENCES
MASTER OF SCIENCE

Syllabus Details

Effective Year 2019-20

Degree : M.Sc. (PHY) **Semester** : 1
Total Subjects : 9
Total Regular Subjects : 6
Total Elective Subjects : 3

Group Name : Regular

Course Code	Course Title	Teaching Scheme					Examination Scheme						
		CREDIT				TOTAL HOURS	TH		PR		PRJ		TOTAL
		TH	PR	PRJ	TOTAL		Internal	External	Internal	External	Internal	External	
PS725	MATHEMATICAL METHODS OF PHYSICS	4.00			4.00	4.00	0/30	28/70	-	-	-	-	100
PS726	CLASSICAL MECHANICS	4.00			4.00	4.00	0/30	28/70	-	-	-	-	100
PS727	ELECTRONICS	4.00			4.00	4.00	0/30	28/70	-	-	-	-	100
PS728	LABORATORY PHYSICS-I: ANALOG AND DIGITAL ELECTRONICS		4.00		4.00	6.00	-	-	0/50	40/100	-	-	150
PS729	LABORATORY PHYSICS-II: COMPUTER PROGRAMMING		4.00		4.00	6.00	-	-	0/50	40/100	-	-	150
PS730	SPECIAL THEORY OF RELATIVITY	2.00			2.00	2.00	0/15	14/35	-	-	-	-	50
					22.00	**26.00**							**650**

Group Name : HSS-PHY-I

Course Code	Course Title	Teaching Scheme					Examination Scheme						
		CREDIT				TOTAL HOURS	TH		PR		PRJ		TOTAL
		TH	PR	PRJ	TOTAL		Internal	External	Internal	External	Internal	External	
HS704 E	ACADEMIC SPEAKING		2.00		2.00	2.00	-	-	0/30	28/70	-	-	100
HS703.01 E	LANGUAGES (FRENCH)		2.00		2.00	2.00	-	-	0/30	28/70	-	-	100

Total Credit for Regular Subjects	:	22.00
Total Credit for Elective Subjects	:	4.00
Total Credit	:	26.00

CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY Date : 29/06/2019

P. D. PATEL INSTITUTE OF APPLIED SCIENCES
MASTER OF SCIENCE

Syllabus Details

Effective Year 2019-20

Degree	: M.Sc. (PHY)	**Semester**	: 1
Total Subjects	: 9		
Total Regular Subjects	: 6		
Total Elective Subjects	: 3		

Examination Grade Range & Value

Grade	Grade Points	From Marks	To Marks
AA	10.00	80	100
AB	9.00	75	79
BB	8.00	70	74
BC	7.00	65	69
CC	6.00	60	64
CD	5.00	55	59
DD	4.00	50	54
FF	0.00	0	49

PS725 Mathematical Methods of Physics

1.	Department/Centre/School proposing the course		PHYSICS
2.	Course Title		Mathematical Methods of Physics
3.	L-T-P structure		3-1-0
4.	Credits		4
5.	Course number		PS725
6.	Course Status (Course Category for Program) PG		
	Programme Core for:		M.Sc. Physics
7.	Pre-requisite(s)		NIL
8.	Status vis-à-vis other courses		
	8.1 List of courses precluded by taking this course (significant overlap)		
	(a)	Significant Overlap with any UG/PG course of the Dept./Centre/ School	NIL
	(b)	Significant Overlap with any UG/PG course of other Dept./Centre/ School	NIL
9.	Not allowed for		NIL
10.	Course offered in		Semester -1
11.	Faculty who will teach the course: Dr. Krunal Kachhia/Dr. Bhaskar Borah/Dr. Sweta Dabhi		
12.	Will the course require any visiting faculty?		No
13.	Course objectives "To introduce students to various mathematical methods useful in Physics. To provide problem solving techniques using these mathematical methods "		
14.	Course contents: "Complex functions, Analytic function, Complex Integration, Cauchy's theorem, residue theorem, transformations of elementary functions, conformable mappings, vector spaces,operators, inner product, orthogonallity and completeness, eigenvalue problem, diagonalization, Hilbert space, Tensors, Kronecker and Levi Civita tensors, inner and outer products, symmetric and antisymmetric tensors, covariant and contravariant tensors, group Theory, Fourier transform, FT of Dirac delta functions, Application to the solutions of differential equations "		
15.	Lecture Outline(with topics and number of lectures)		
	Module no.	Topic	No. of hours
	1	Complex functions, Analytic function, Complex Integration, Cauchy's theorem, residue theorem, transformations of elementary functions, conformable mappings	14
	2	vector spaces,operators, inner product, orthogonallity and completeness, eigenvalue problem, diagonalization, Hilbert space	10

	3	Fourier transform, FT of Dirac delta functions, Application to the solutions of differential equations	6
	4	Tensors, Kronecker and Levi Civita tensors, inner and outer products, symmetric and antisymmetric tensors, covariant and contravariant tensors	6
	5	Group Theory, Preliminaries, Isomorphism and homomorphism, group representation, Lorentz group.	6
16.	Brief description of tutorial activities:		
	Module no.	Description	No. of hours
	1	Analysis of Complex functions, Analytic functions, Cauchy theorem, Cauchy integral formula, Residue theorem.	04
	2	Vector space, Linear transformations, Hilbert space	04
	3	Fourier transform and its applications	02
	4	Introduction to Tensors,	02
	5	Group Theory	02
17.	Brief description of Practical / Practice activities		
	Module no.	Description	No. of hours
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18.	Brief description of module-wise activities pertaining to self-learning component (Include topics that the students would do self-learning from books / resource materials: Do not Include assignments / term papers etc.)		
	Module no.	Description	
	Module 1	Real Functions, Complex Numbers	
	Module 2	Matrices	
19.	Suggested texts and reference materials STYLE: Author name and initials, Title, Edition, Publisher, Year		
	1. F. W. Byron and R. W. Fuller, Mathematics of Classical and Quantum Physics, Vol 1-2, Dover Publications, Inc., New York, 1992. 2. Complex Variables and Applications, J.W. Brown & R.V. Churchill, 7th Ed. 2003, Tata McGraw-Hill. 3. Mary L Boss , Mathematical Methods in Physical Sciences, 3rd Edition, John Wiley & Sons, India. 4. Arfken& Weber, Mathematical Methods for Physicists (6th edition), Elsevier, Academic Press (2012). 5. Mathematical Methods for Physicists and Engineers, by K.F. Reily, M.P. Hobson and S.J. Bence.		
20.	Resources required for the course (itemized student access requirements, if any)		
	20.1	Software	C/C++/Fortran compilers, Codeblock
	20.2	Hardware	Computers
	20.3	Teaching aids (videos, etc.)	Not as such
	20.4	Laboratory	Computer Laboratory
	20.5	Equipment	Computers
	20.6	Classroom infrastructure	Black board and projector
	20.7	Site visits	Not required
	20.8	Others (please specify)	None

21.	Design content of the course (Percent of student time with examples, if possible)	
	Design-type problems	Nil
	Open-ended problems	Nil
	Project-type activity	Nil
	Open-ended laboratory work	Nil
	Others (please specify)	Nil

PS726 CLASSICAL MECHANICS

1.	Department/Centre/School proposing the course		PHYSICS
2.	Course Title		Classical Mechanics
3.	L-T-P structure		3-1-0
4.	Credits		4
5.	Course number		PS726
6.	Course Status (Course Category for Program) PG		
	Programme Core for:		M.Sc. Physics
7.	Pre-requisite(s)		NIL
8.	Status vis-à-vis other courses		
	8.1 List of courses precluded by taking this course (significant overlap)		
	(a)	Significant Overlap with any UG/PG course of the Dept./Centre/ School	NIL
	(b)	Significant Overlap with any UG/PG course of other Dept./Centre/ School	NIL
9.	Not allowed for		NIL
10.	Course offered in		Semester 1
11.	Faculty who will teach the course: Kinnari Parekh, Bhaskar Borah, Manan Shah, Shweta Dabhi		
12.	Will the course require any visiting faculty?		No
13.	Course objectives "On successful completion of this course, a student should be able to understand the basics of Classical Mechanics and its formal aspects thoroughly"		
14.	Course contents: constraints, generalized coordinates, action principle, symmetries and conservation laws, Hamilton's equations, poisson brackets, canonical transformations, central potentials, small oscillations, normal modes, rigid body dynamics.		
15.	Lecture Outline(with topics and number of lectures)		

	Module no.	Topic	No. of hours
	1	Constraints and generalized coordinates, Principle of virtual work, D'Alembert's Principle, Examples.	4
	2	Action principle, Lagrangian equations of motion and its applications, Lagrange undetermined multipliers, velocity dependent potentials, dissipation function, applications of Lagrange formulations	6
	3	Symmetries and conservation laws, invariance and Noether's theorem	4
	4	Conservation laws and cyclic coordinates, Canonical equation of motion (Hamiltonian	8

		formalism and equations of motion), Poisson brackets and canonical transformations, examples, phase space, Liouville's equation	
	5	Central force motions, Motion in Central force, classification of orbits, Kepler's laws, scattering in a central field	6
	6	Small oscillations, coupled oscillations, normal modes, characteristic frequencies, forced oscillations	6
	7	Rigid body motions and pseudo forces, Rigid body dynamics, moment of inertia tensor, Non-inertial frames and pseudo forces, Euler's angle, Euler's equations, symmetric top	8
16.	Brief description of tutorial activities:		
	Module no.	Description	No. of hours
	1	Problem sessions constraints & D'Alembert's principle	1
	2	Problem sessions for , Lagrangian equations of motion and its applications, Lagrange undetermined multipliers,	3
	3	Symmetries and conservation laws, invariance and Noether's theorem	1
	4	Hamiltonian formalism and equations of motion), Poisson brackets and canonical transformations	2
	5	Central force motions	2
	6	Small oscillations, normal modes, characteristic	3
	7	Rigid body motions & Dynamics	2
17.	Brief description of Practical / Practice activities		
	Module no.	Description	No. of hours
	--	NIL	--
18.	Brief description of module-wise activities pertaining to self-learning component (Include topics that the students would do self learning from books / resource materials: Do not Include assignments / term papers etc.)		
	Module no.	Description	
19.	Suggested texts and reference materials STYLE: Author name and initials, Title, Edition, Publisher, Year		
	1. "Classical Mechanics" (Addison Wesley, Third Edition) - H. Goldstein, C. Poole and J. Safko. 2. "Mechanics (Theoretical Physics Vol. 1) - L. Landau and E. Lifschitz. 3. Classical Mechanics – System of particles and Hamiltonian Dynamics' by Greiner, Springer International Ed. 2006 4. Classical Mechanics by G.Aruldhas, PHI 5. Classical Mechanics – N C Rana and P S Jog, Tata McGraw Hill, 1991 6. Classical Mechanics,- YaswantWaghmere 7. Introductory Classical Mechanics with problems and solutions- David Morin		

20.	Resources required for the course (itemized student access requirements, if any)		
	20.1	Software	NIL
	20.2	Hardware	NIL
	20.3	Teaching aids (videos, etc.)	NIL
	20.4	Laboratory	NIL
	20.5	Equipment	NIL
	20.6	Classroom infrastructure	Blackboard-choke
	20.7	Site visits	NIL
	20.8	Others (please specify)	NIL
21.	Design content of the course (Percent of student time with examples, if possible)		
	Design-type problems		NIL
	Open-ended problems		NIL
	Project-type activity		NIL
	Open-ended laboratory work		NIL
	Others (please specify)		NIL

PS727 Electronics

1.	Department/Centre/School proposing the course		PHYSICS
2.	Course Title		Electronics
3.	L-T-P structure		3-1-0
4.	Credits		4
5.	Course number		PS727
6.	Course Status (Course Category for Program) PG		
	Programme Core for:		M.Sc. Physics
7.	Pre-requisite(s)		Knowledge of I-V characteristics of transistor and fundamental laws of electronics
8.	Status vis-à-vis other courses		
	8.1 List of courses precluded by taking this course (significant overlap)		
	(a)	Significant Overlap with any UG/PG course of the Dept./Centre/ School	M.Sc. (Physics) Sem-I Laboratory Physics Course-1 : Analog and Digital Electronics
	(b)	Significant Overlap with any UG/PG course of other Dept./Centre/ School	Some points like basic of Op-Amps and digital electronics are usually covered in B.Sc. syllabus. However, for the sake of continuity it is covered in the present syllabus.
9.	Not allowed for		--
10	Course offered in		Semester 1
11	Faculty who will teach the course: Dr. Rucha Desai, Dr. C K Sumesh, Prof. R V Upadhyay		
12	Will the course require any visiting faculty?		No
13	**Course objectives** The objective of the course is to explain the importance of electronic circuits and its applications. Nowadays, most of the circuits are using integrated circuits (ICs), and hence this course discusses the fundamental operations of few integrated circuits and subsequently its applications. As this course is overlap with Laboratory Physics Course-1 : Analog and Digital Electronics, students will also simulate the circuits and understand the effect of variation of different components (parameters). Also during this lab, by soldering the circuits student will verify the simulated results.		
14	Course contents: Linear and analog integrated circuits, timer circuits, frequency and phase modulations, digital circuits, shift registers, counters, introduction to microprocessor		
15	Lecture Outline(with topics and number of lectures)		

	Module no.	Topic	No. of hours
	1	Op-Amp (IC-741): Internal Structure (Block Diagram) Slew Rate, Frequency Response and Compensation, Applications (Linear and Non-Linear).	10
	2	Timer (IC-555):	07

		Internal Structure (Block Diagram) Operation, Astable, Monostable and Applications.	
	3	Phase Locked Loops (IC-565): Internal Structure (Block) Diagram) Application as Frequency Multiplication, Division FSK and FM Demodulation.	04
	4	Digital ICs-I: TTl, MOS and CMOS Gates, Parrallel Binary adder/subtractor, BCD Addition/Subtraction, Encoder, Decoder, MUX, DE-MUX, Flip-Flops	09
	5	Digital ICs-II: Shift Resister, Counter, Memory Concept, RAM and ROM. Introduction to Microprocessor 8085	09
16	Brief description of tutorial activities: Problem sessions and clarification of doubts		
	Module no.	Topic Description	No. of hours
	1	Op-Amp (IC-741): Internal Structure (Block Diagram) Slew Rate, Frequency Response and Compensation, Applications (Linear and Non- Linear).	04
	2	Timer (IC-555): Internal Structure (Block Diagram) Operation, Astable, Monostable and Applications.	03
	3	Phase Locked Loops (IC-565): Internal Structure (Block) Diagram) Application as Frequency Multiplication, Division FSK and FM Demodulation	02
	4	Digital ICs-I: TTl, MOS and CMOS Gates, Parrallel Binary adder/subtractor, BCD Addition/Subtraction, Encoder, Decoder, MUX, DE-MUX, Flip-Flops	04
	5	Digital ICs-II: Shift Resister, Counter, Memory Concept, RAM and ROM. Introduction to Microprocessor 8085	04
17	Brief description of Practical / Practice activities: Refer to Laboratory Physics Course-1 : Analog and Digital Electronics		
	Module no.	Description	No. of hours
18	Brief description of module-wise activities pertaining to self-learning component (Include topics that the students would do self-learning from books / resource materials: Do not Include assignments / term papers etc.)		
	Module no.	Description	
	1	Op-Amp (IC-741): Linear and Non- Linear applications	
	2	Timer (IC-555):Applications of multivibrators	
	3	Phase Locked Loops (IC-565): examples of FSK and FM Demodulation	
	4	Digital ICs-I: examples	
	5	Digital ICs-II: examples	
19	Suggested texts and reference materials STYLE: Author name and initials, Title, Edition, Publisher, Year		
	1) Ramakant A.Gayakward- Op-Amps and linear integrated circuits-Pearson Education. 2) A. Anand Kumar - Fundamentals of Digital Circuits		

	3) Ramesh Goankar- Microprocessor Architecture, Programming and application with the 8085-Penram International Publishing Company.		
20	Resources required for the course (itemized student access requirements, if any)		
	20.1	Software	LSpice/PSpice – openware
	20.2	Hardware	Window based computer system (window 10 or higher)
	20.3	Teaching aids (videos, etc.)	Writing board, projector
	20.4	Laboratory	Lab. Equipped to perform electronics experiments
	20.5	Equipment	Common essential requirements: Fixed voltage power supply (±5 V, ± 15 V), variable power supply (0 – 30 V), CRO, DMM, Frequency generator (amplitude range microvolt to volts)
	20.6	Classroom infrastructure	Yes
	20.7	Site visits	Yes
	20.8	Others (please specify)	Nil
21	Design content of the course (Percent of student time with examples, if possible)		
	Design-type problems		25% of student time of tutorial/assignment: Basic circuit design exercise
	Open-ended problems		10-15% of student time
	Project-type activity		10-15% of student time
	Open-ended laboratory work		10-15% of student time
	Others (please specify)		Nil

PS728 Laboratory Physics-1 : Analog and Digital Electronics

1.	Department/Centre/School proposing the course		PHYSICS
2.	Course Title		Laboratory Physics Course-1 : Analog and Digital Electronics
3.	L-T-P structure		0-0-6
4.	Credits		4
5.	Course number		PS728
6.	Course Status (Course Category for Program) PG		
	Programme Core for:		M.Sc. Physics
7.	Pre-requisite(s)		Knowledge of I-V characteristics of transistor and fundamental laws of electronics
8.	Status vis-à-vis other courses		
	8.1 List of courses precluded by taking this course (significant overlap)		
	(a)	Significant Overlap with any UG/PG course of the Dept./Centre/ School	M.Sc. (Physics) Sem-I Electronics theory course
	(b)	Significant Overlap with any UG/PG course of other Dept./Centre/ School	Some points like basic of Op-Amps and digital electronics are usually covered in B.Sc. syllabus. However, for the sake of continuity it is covered in the present syllabus.
9.	Not allowed for		Nil
10.	Course offered in		Semester -1
11.	Faculty who will teach the course: Dr. Rucha Desai, Dr. C K Sumesh, Prof. R V Upadhyay		
12.	Will the course require any visiting faculty?		No
13.	Course objectives "On successful completion of this course, a student should be able to design, develop, and simulate the circuit(s) followed experimental verification of the results."		
14.	Course contents: Linear and analog integrated circuits, timer circuits, frequency and phase modulations, digital circuits, shift registers, counters, introduction to microprocessor		
15.	Lecture Outline(with topics and number of lectures): Lectures covered in Electronics (theory) course		
	Module no.	Topic	No. of hours
16.	Brief description of tutorial activities: Doubts will be solved during practical sessions.		
	Module no.	Description	No. of hours
	Total Tutorial hours		

17.	Brief description of Practical / Practice activities		
	Module no.	Description	No. of hours
	1	Op-Amp (IC-741): Internal Structure (Block Diagram) Slew Rate, Frequency Response and Compensation, Applications (Linear and Non- Linear).	30
	2	Timer (IC-555): Internal Structure (Block Diagram) Operation, Astable, Monostable and Applications.	20
	3	Phase Locked Loops (IC-565): Internal Structure (Block) Diagram) Application as Frequency Multiplication, Division FSK and FM Demodulation	06
	4	Digital ICs-I: TTl, MOS and CMOS Gates, Parrallel Binary adder/subtractor, BCD Addition/Subtraction, Encoder, Decoder, MUX, DE-MUX, Flip-Flops	13
	5	Digital ICs-II: Shift Resister, Counter, Memory Concept, RAM and ROM. Introduction to Microprocessor 8085	15
18.	Brief description of module-wise activities pertaining to self-learning component (Include topics that the students would do self-learning from books / resource materials: Do not Include assignments / term papers etc.)		
	Module no.	Description	
	1	Simulation and design aspect of experiments related to Op-Amp (IC-741)	
	2	Simulation and design aspect of experiments related Timer (IC-555)	
	3	Simulation and design aspect of experiments related Phase Locked Loops (IC-565)	
	4	Simulation and design aspect of experiments related Digital ICs-I	
	5	Simulation and design aspect of experiments related Digital ICs-II	
19.	Suggested texts and reference materials STYLE: Author name and initials, Title, Edition, Publisher, Year		
	4) Ramakant A.Gayakward- Op-Amps and linear integrated circuits-Pearson Education. 5) A. Anand Kumar - Fundamentals of Digital Circuits 6) Ramesh Goankar- Microprocessor Architecture, Programming and application with the 8085-Penram International Publishing Company.		
20.	Resources required for the course (itemized student access requirements, if any)		
	20.1	Software	LSpice/PSpice – openware
	20.2	Hardware	Window based computer system (window 10 or higher)
	20.3	Teaching aids (videos, etc.)	Writing board, projector
	20.4	Laboratory	Lab. Equipped to perform electronics experiments
	20.5	Equipment	Common essential requirements: Fixed voltage power supply (±5 V, ± 15 V), variable power supply (0 – 30 V), CRO,

			DMM, Frequency generator (amplitude range microvolt to volts)
	20.6	Classroom infrastructure	Yes
	20.7	Site visits	No
	20.8	Others (please specify)	
21.	Design content of the course (Percent of student time with examples, if possible)		
	Design-type problems		25% of student time of tutorial/assignment: Basic circuit design exercise
	Open-ended problems		10-15% of student time
	Project-type activity		10-15% of student time
	Open-ended laboratory work		10-15% of student time
	Others (please specify)		Nil

PS729 Laboratory Physics-2: Computer Programming

1.	Department/Centre/School proposing the course		PHYSICS
2.	Course Title		Laboratory Physics Course 2: Computer Programming
3.	L-T-P structure		1-1-4
4.	Credits		4
5.	Course number		PS729
6.	Course Status (Course Category for Program) PG		
	Programme Core for:		M.Sc. Physics
7.	Pre-requisite(s)		Preferable: Introduction to computer, types of programming languages
8.	Status vis-à-vis other courses		
	8.1 List of courses precluded by taking this course (significant overlap)		
	(a)	Significant Overlap with any UG/PG course of the Dept./Centre/ School	NIL
	(b)	Significant Overlap with any UG/PG course of other Dept./Centre/ School	NIL
9.	Not allowed for		NIL
10.	Course offered in		Semester 1
11.	Faculty who will teach the course: Dr. Rucha Desai, Dr. Bhaskar Borah, Dr. Shweta Dabhi		
12.	Will the course require any visiting faculty?		No
13.	Course objectives a. The objective of the course is to introduce students to computer programming. b. To explore students for logic development for writing various programs. This will be useful later for writing programs to solve scientific theories/equations.		
14.	Course contents: Introduction to language and simple programming, Control and loop structures, Arrays and functions		
15.	Lecture Outline(with topics and number of lectures)		

	Module no.	Topic	No. of hours
	1	Introduction to language and simple programming: Integer and floating point arithmetic, Precision, Variable types, Arithmetic statements, Input and output statements, Executable and non-executable statements, Operating systems	04
	2	Control and loop structures: Control structures	05
	3	Arrays and functions: Arrays, Repetitive and logical structures, Subroutines and functions, Operation with files	05

16.	Brief description of tutorial activities: Problem sessions and clarification of doubts.		
	Module no.	Description	No. of hours
	1	Introduction to language and simple programming: Integer and floating point arithmetic, Precision, Variable types, Arithmetic statements, Input and output statements,	04
	2	Control and loop structures: Control structures, Executable and non-executable statements	05
	3	Arrays and functions: Arrays, Repetitive and logical structures, Subroutines and functions, Operation with files, Operating systems, Creation of executable programs	05
17.	Brief description of Practical / Practice activities		
	Module no.	Description	No. of hours
	1	Introduction to language and simple programming: Integer and floating point arithmetic, Precision, Variable types, Arithmetic statements, Input and output statements,	16
	2	Control and loop structures: Control structures, Executable and non-executable statements	20
	3	Arrays and functions: Arrays, Repetitive and logical structures, Subroutines and functions, Operation with files, Operating systems, Creation of executable programs	20
18.	Brief description of module-wise activities pertaining to self-learning component (Include topics that the students would do self-learning from books / resource materials: Do not Include assignments / term papers etc.)		
	Module no.	Description	
	1	Simple program including basic syntax	
	2	Programs including looping structure	
	3	Programs including concepts of arrays and functions	
19.	Suggested texts and reference materials :		
	1. Programming in C, E Balagurusamy, Tata McGraw-Hill Education 2. Let Us C, Yashwant P Kanetkar, BPB Publications 3. C Language and Numerical Methods by C. Xavier, New Age International Publication 4. Programming with C, Byron Gottfried, Schaum's outlines, McGraw Hill Publications 5. C for Beginners, Madhusudan Mothe, Shroff pubshers 6. Computer Oriented Numerical Methods, V. Rajaraman, PHI Learning Publisher		
20.	Resources required for the course (itemized student access requirements, if any)		
	20.1	Software	"C" or "C++" supported compiler

	20.2	Hardware	Computer system (Window 10 or higher)
	20.3	Teaching aids (videos, etc.)	Writing board, Projection System
	20.4	Laboratory	Computer lab
	20.5	Equipment	Nil
	20.6	Classroom infrastructure	Yes
	20.7	Site visits	Nil
	20.8	Others (please specify)	
21.	Design content of the course (Percent of student time with examples, if possible)		
	Design-type problems		20% of student time of practice hours
	Open-ended problems		Nil
	Project-type activity		Nil
	Open-ended laboratory work		Nil
	Others (please specify)		Nil

Semester 2

PS751 Electrodynamics

1.	Department/Centre/School proposing the course		PHYSICS
2.	Course Title		Electrodynamics
3.	L-T-P structure		3-1-0
4.	Credits		4
5.	Course number		PS751
6.	Course Status (Course Category for Program) PG		
	Programme Core for:		M.Sc. Physics
7.	Pre-requisite(s)		NIL
8.	Status vis-à-vis other courses		
	8.1 List of courses precluded by taking this course (significant overlap)		
	(a)	Significant Overlap with any UG/PG course of the Dept./Centre/ School	NIL
	(b)	Significant Overlap with any UG/PG course of other Dept./Centre/ School	NIL
9.	Not allowed for		NIL
10.	Course offered in		Semester 2
11.	Faculty who will teach the course: Dr. Bhaskar Borah/Dr. Sweta Dabhi/Prof. R. V. Upadhyay		
12.	Will the course require any visiting faculty?		No
13.	Course objectives "On successful completion of this course, a student should be able to understand the advance concepts of electromagnetic theory and applications"		
14.	Course contents: Review of electrostatics and Magnetostatics, Faraday's laws, Maxwell's equations, Scalar and vector potentials, Concepts of Gauge and Gauge invariance, Poynting's theorem and conservation laws, boundary conditions, electromagnetic wave propagation in space and medium, reflection and transmission of EM waves on an interface, wave guides, resonant cavities, Lorentz transformations, covariance of electrodynamics: 4-vectors and tensors, covariant formulation of Electrodynamics, Lagrangian for EM field, motion of a charged particle in EM fields, electric dipole, electric quadrapole and magnetic dipole radiation, radiation by a moving charge		
15.	Lecture Outline(with topics and number of lectures)		
	Module no.	Topic	No. of hours
	1	Review of electrostatics and Magnetostatics, Faraday's laws, Maxwell's equations, Scalar and vector potentials, Concepts of Gauge and Gauge invariance, Poynting's theorem and conservation laws, boundary conditions	6

	2	electromagnetic wave propagation in space and medium, reflection and transmission of EM waves on an interface, wave guides, resonant cavities	10
	3	Lorentz transformations, covariance of electrodynamics: 4-vectors and tensors, covariant formulation of Electrodynamics, electrodynamics field tensor, Lagrangian for EM field, motion of a charged particle in EM fields	16
	4	electric dipole, electric quadrapole and magnetic dipole radiation, radiation by a moving charge	10
16.	Brief description of tutorial activities:		
	Module no.	Description	No. of hours
	1	Tutorials will be discussed on electrostatics and magnetostatics and other topics	4
	2	Discussions of application of various concepts of different topics to solve numerical problems	3
	3	Problem solution sessions and clarification of doubts	4
	4	Problem solution sessions and clarification of doubts	3
17.	Brief description of Practical / Practice activities		
	Module no.	Description	No. of hours
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18.	Brief description of module-wise activities pertaining to self-learning component (Include topics that the students would do self-learning from books / resource materials: Do not Include assignments / term papers etc.)		
	Module no.	Description	
	Module 1	Electrostatics and Magnetostatics	
	Module 2	Basics of waves and polarization	
	Module 3	Basics of special theory of relativity and introduction to tensors	
19.	Suggested texts and reference materials STYLE: Author name and initials, Title, Edition, Publisher, Year		
	1. David J. Griffiths, Introduction to Electrodynamics, 4th edition, Pearson New International Edition, 2014 2. Matthew N. O. Sadiku, Principles of Electromagnetics, 4th edition, Oxford international Students, 2009 3. Walter Greiner, Classical electrodynamics, Springer, Paperback, 2006		
20.	Resources required for the course (itemized student access requirements, if any)		
	20.1	Software	No software required
	20.2	Hardware	No hardware required
	20.3	Teaching aids (videos, etc.)	Not as such

	20.4	Laboratory	No Laboratory required
	20.5	Equipment	No equipment required
	20.6	Classroom infrastructure	No specific facility required
	20.7	Site visits	Not required
	20.8	Others (please specify)	None
21.	Design content of the course (Percent of student time with examples, if possible)		
	Design-type problems		Nil
	Open-ended problems		Nil
	Project-type activity		Nil
	¤ Open-ended laboratory work		Nil
	Others (please specify)		Nil

PS752 Thermodynamics and Statistical Mechanics

1.	Department/Centre/School proposing the course		PHYSICS
2.	Course Title		Thermodynamics and Statistical Mechanics
3.	L-T-P structure		3-1-0
4.	Credits		4
5.	Course number		PS752
6.	Course Status (Course Category for Program) PG		
	Programme Core for:		M.Sc. Physics
7.	Pre-requisite(s)		NIL
8.	Status vis-à-vis other courses		
	8.1 List of courses precluded by taking this course (significant overlap)		
	(a)	Significant Overlap with any UG/PG course of the Dept./Centre/ School	NIL
	(b)	Significant Overlap with any UG/PG course of other Dept./Centre/ School	NIL
9.	Not allowed for		NIL
10.	Course offered in		Semester-2
11.	Faculty who will teach the course:		Dr. Bhaskar Borah/Dr. Sweta Dabhi
12.	Will the course require any visiting faculty?		No
13.	Course objectives "On successful completion of this course, a student should be able to understand statistical mechanics as a tool can help in studying thermodynamics of a macroscopic system. The course will illuminate on how the macroscopic behavior of a system, the thermodynamics, is related to the microscopic arrangements of the constituent atoms and molecules of a given system."		
14.	Course contents: Laws of thermodynamics, thermodynamic potentials and stability conditions, concepts of phase space and Liouville's theorem, elementary probability theory, distribution functions, central limit theorem, counting principles, formulation of classical statistical mechanics, ensemble theory, fluctuations, statistics of paramagnetic systems, equipartition theorem, formulation of quantum statistics, introduction to density matrix, Bose-Einstein and Fermi-Dirac statistics, ideal Fermi gas, ideal Bose gas, Specific heats of solids, Fermi energy and mean energy, Fermi temperature, electron degeneracy and white dwarf stars		
15.	Lecture Outline(with topics and number of lectures)		
	Module no.	Topic	No. of hours
	1	Laws of thermodynamics, thermodynamics potentials and stability conditions, concepts of phase space and Liouville's theorem	6
	2	elementary probability theory, distribution functions, central limit theorem, counting principles	6

	3	formulation of classical statistical mechanics, ensemble theory, fluctuations, statistics of paramagnetic systems, equipartition theorem	10
	4	formulation of quantum statistics, introduction to density matrix, Bose-Einstein and Fermi-Dirac statistics	10
	5	ideal Fermi gas, ideal Bose gas, Fermi energy and mean energy, Fermi temperature, electron degeneracy and white dwarfs stars	10
16.	Brief description of tutorial activities:		
	Module no.	Description	No. of hours
	1	Tutorials on laws of thermodynamics and phase space	2
	2	Probability theory and Probability distributions	2
	3	Ideal gas, Paramagnetic systems, harmonic oscillator	4
	4	Ideal gas, paramagnetic systems, specific heats of solid, metals, harmonic oscillator	3
	5	Electron degeneracy and various applications	3
17.	Brief description of Practical / Practice activities		
	Module no.	Description	No. of hours
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18.	Brief description of module-wise activities pertaining to self-learning component (Include topics that the students would do self-learning from books / resource materials: Do not Include assignments / term papers etc.)		
	Module no.	Description	
	Module 1	Hamiltonian mechanics from classical mechanics	
	Module 2	Permutation and combination, combinatorics, counting principles	
	Module 4	States of a system in quantum mechanics, Solutions of Schrodinger equation for simple problems like particle in a box, harmonic oscillator	
19.	Suggested texts and reference materials STYLE: Author name and initials, Title, Edition, Publisher, Year		
	1. R. K. Pathria and Paul D. Beale, Statistical Mechanics, 3rd Edition, Academic Press, 2012 2. F. Reif, Fundamentals of Statistical and Thermal Physics, International Student Ed., McGraw Hill. 3. Zemansky and Dittman, Heat and Thermodynamics 4. Sheng-Keng Ma, Statistical Mechanics, World Scientific		
20.	Resources required for the course (itemized student access requirements, if any)		
	20.1	Software	No software required
	20.2	Hardware	No hardware required
	20.3	Teaching aids (videos, etc.)	Not as such
	20.4	Laboratory	No Laboratory required
	20.5	Equipment	No equipment required
	20.6	Classroom infrastructure	No specific facility required
	20.7	Site visits	Not required
	20.8	Others (please specify)	None
21.	Design content of the course (Percent of student time with examples, if possible)		
	Design-type problems		Nil

	Open-ended problems	Nil
	Project-type activity	Nil
	¤ Open-ended laboratory work	Nil
	Others (please specify)	Nil

PS753 Quantum Mechanics – I

1.	Department/Centre/School proposing the course		PHYSICS	
2.	Course Title		Quantum Mechanics – I	
3.	L-T-P structure		3-1-0	
4.	Credits		4	
5.	Course number		PS753	
6.	Course Status (Course Category for Program) PG			
	Programme Core for:		M.Sc. Physics	
7.	Pre-requisite(s)		Concepts of vector space, Hilbert space, Dirac notations	
8.	Status vis-à-vis other courses			
	8.1 List of courses precluded by taking this course (significant overlap)			
	(a)	Significant Overlap with any UG/PG course of the Dept./Centre/ School	NIL	
	(b)	Significant Overlap with any UG/PG course of other Dept./Centre/ School	NIL	
9.	Not allowed for		NIL	
10.	Course offered in		Semester -2	
11.	Faculty who will teach the course:		Dr. Bhaskar Borah/Dr. Sweta Dabhi	
12.	Will the course require any visiting faculty?		No	
13.	Course objectives "On successful completion of this course, a student should be able to understand the basics and the formulation of quantum mechanics with some applications"			
14.	Course contents: Postulates of quantum mechanics, one-dimensional problems, Tunneling problem, 3D problems, symmetry and degeneracy, Angular momentum algebra, hydrogen atom, Time independent and time dependent perturbation theory, Zeeman and Stark effect, Variational method			
15.	Lecture Outline(with topics and number of lectures)			
	Module no.	Topic		No. of hours
	1	Dirac notations and bra ket algebra		2
	2	Postulates of quantum mechanics, one dimensional problems		6
	3	3D problems, symmetry and degeneracy, tunneling problem		8
	4	Angular momentum algebra, hydrogen atom		8
	5	Time independent perturbation theory		10
	6	Zeeman and Stark effect, Variational Method		6
16.	Brief description of tutorial activities:			
	Module no.	Description		No. of hours

	1	Tutorials and problem solution related to eigenvalue problem, linear independency and linear dependency of vectors, basis transformation	2
	2	Problem sessions and clarification of doubts related to the postulates of quantum mechanics and their applications	2
	3	Discussion of various 3D problems	2
	4	Tutorials on angular momentum algebra and related numerical of hydrogenic systems	2
	5	Problem sessions and clarification of doubts.	2
	6	Problem sessions and clarification of doubts.	2
17.	Brief description of Practical / Practice activities		
	Module no.	Description	No. of hours
	Module 2	Solving Schrodinger equation and plotting wave functions and probability distributions using scilab for some simple problems.	2
	Module 4	Plotting wave functions and probabilities of hydrogen atom energy states using scilab/mathematica.	2
18.	Brief description of module-wise activities pertaining to self-learning component (Include topics that the students would do self-learning from books / resource materials: Do not Include assignments / term papers etc.)		
	Module no.	Description	
	Module 1	Matrix algebra: symmetric and antisymmetric matrix, Hermitian matrix, unitary matrix, identity matrix, inverse of a matrix, solving eigenvalue problem, diagonalization of a matrix	
	Module 2	Properties of wave functions and implication of boundary conditions in solving differential equations	
	Module 4	Coordinate transformations and derivation of the angular momentum operators in terms of spherical coordinates	
19.	Suggested texts and reference materials STYLE: Author name and initials, Title, Edition, Publisher, Year		
	1. *Quantum Mechanics Concepts and Applications, N.* Zettilli, (Wiley) 2. Introductory Quantum Mechanics, Richard L. Liboff (Pearson). 3. *Quantum Mechanics, David J. Griffiths (Cambridge University)* 4. *Quantum Mechanics,* L. I. Schiff, (McGraw-Hill).		
20.	Resources required for the course (itemized student access requirements, if any)		
	20.1	Software	Scilab/mathematics
	20.2	Hardware	No hardware required
	20.3	Teaching aids (videos, etc.)	Not as such
	20.4	Laboratory	Computer Laboratory
	20.5	Equipment	Computers
	20.6	Classroom infrastructure	No specific facility required
	20.7	Site visits	Not required
	20.8	Others (please specify)	None
21.	Design content of the course (Percent of student time with examples, if possible)		
	Design-type problems		Nil
	Open-ended problems		Nil
	Project-type activity		Nil

	Open-ended laboratory work	Nil
	Others (please specify)	Nil

PS754 Laboratory Physics3: Numerical Analysis

1.	Department/Centre/School proposing the course		PHYSIC
2.	Course Title		Laboratory Physics Course 3: Numerical Analysis
3.	L-T-P structure		1-1-4
4.	Credits		4
5.	Course number		PS754
6.	Course Status (Course Category for Program) PG		
	Programme Core for:		M.Sc. Physics
7.	Pre-requisite(s)		Basic knowledge of computer programming language. Student should be completed M.Sc. (sem-I) course on Laboratory Physics Course – 2 : Computer Programming
8.	Status vis-à-vis other courses		
	8.1 List of courses precluded by taking this course (significant overlap)		
	(a)	Significant Overlap with any UG/PG course of the Dept./Centre/ School	NIL
	(b)	Significant Overlap with any UG/PG course of other Dept./Centre/ School	NIL
9.	Not allowed for		NIL
10.	Course offered in		Semester 2
11.	Faculty who will teach the course: Dr. Rucha Desai, Dr. Bhaskar Borah, Dr. Shweta Dabhi		
12.	Will the course require any visiting faculty?		No
13.	Course objectives "On successful completion of this course, a student should be able to understand various solving methods and implement them in analysis"		
14.	Course contents: Data Interpretation and analysis, Least square fitting, Roots of functions, Interpolation – extrapolation, Numerical Integration, and Ordinary differential equation		
15.	Lecture Outline(with topics and number of lectures)		

	Module no.	Topic	No. of hours
	1	Data Interpretation and analysis Precision and accuracy, error analysis, propagation of errors, Numerical errors	06
	2	Simple Least square fitting Linear and non-linear fit, chi-square test	03
	3	Roots of functions	03

		Bisection, Regula- falsi and Newton-Raphson, secant method, fixed point iteration method	
	4	Interpolation – extrapolation Lagrange interpolation, Divided difference method, Spline interpolation	02
	5	Numerical Integration: Trapezoidal, Simpson	02
	6	Ordinary differential equation Solution of ordinary differential equation using Runge-Kutta and Euler methods	02
16.	Brief description of tutorial activities: Problem sessions and clarification of doubts.		
	Module no.	Description	No. of hours
	1	Data Interpretation and analysis: Precision and accuracy, error analysis, propagation of errors, binomial, poison and normal distributions	02
	2	Least square fitting: Linear and non-linear fit, chi-square test	03
	3	Roots of functions: Bisection, Regula- falsi and Newton-Raphson, secant method	03
	4	Interpolation – extrapolation: Lagrange interpolation, Divided difference method, Spline interpolation	02
	5	Numerical Integration: Trapezoidal, Simpson	02
	6	Ordinary differential equation: Solution of ordinary differential equation using Runge-Kutta and Euler methods	02
17.	Brief description of Practical / Practice activities		
	Module no.	Description	No. of hours
	1	Data Interpretation and analysis: Precision and accuracy, error analysis, propagation of errors, binomial, poison and normal distributions	08
	2	Least square fitting: Linear and non-linear fit, chi-square test	12
	3	Roots of functions: Bisection, Regula- falsi and Newton-Raphson, secant method	12
	4	Interpolation – extrapolation: Lagrange interpolation, Divided difference method, Spline interpolation	08
	5	Numerical Integration: Trapezoidal, Simpson	08
	6	Ordinary differential equation: Solution of ordinary differential equation using Runge-Kutta and Euler methods	08
18.	Brief description of module-wise activities pertaining to self-learning component (Include topics that the students would do self-learning from books / resource materials: Do not Include assignments / term papers etc.)		
	Module no.	Description	
	1	Include data interpretation and analysis methods in laboratory experiments	

	2	Perform least square fitting in the experimental data and do error analysis	
	3	Roots of functions: Bisection, Regula- falsi and Newton-Raphson, secant method - Examples	
	4	Interpolation – extrapolation: Lagrange interpolation, Divided difference method, Spline interpolation - Examples	
	5	Numerical Integration: Trapezoidal, Simpson - Examples	
	6	Ordinary differential equation: Solution of first order differential equation using Runge-Kutta and Euler methods - Examples	
19.	Suggested texts and reference materials STYLE:		
	1) Numerical methods for engineers, Chapra and canale, Mc Graw Hill 2) Introductory methods for numerical analysis, S S Sastry,		
20.	Resources required for the course (itemized student access requirements, if any)		
	20.1	Software	Microsoft Excel or open ware spreadsheet, “C” or “C++” supported compiler
	20.2	Hardware	Computer system (Window 10 or higher)
	20.3	Teaching aids (videos, etc.)	Writing board, Projection System
	20.4	Laboratory	Computer lab
	20.5	Equipment	Nil
	20.6	Classroom infrastructure	Yes
	20.7	Site visits	Nil
	20.8	Others (please specify)	
21.	Design content of the course (Percent of student time with examples, if possible)		
	Design-type problems		20% of student time of practice hours
	Open-ended problems		Nil
	Project-type activity		Nil
	Open-ended laboratory work		Nil
	Others (please specify)		Nil

PS755 Laboratory Physics -4: Computational Physics

1.	Department/Centre/School proposing the course		PHYSICS
2.	Course Title		Laboratory Physics Course-4: Computational Physics
3.	L-T-P structure		3-1-0
4.	Credits		4
5.	Course number		PS755
6.	Course Status (Course Category for Program) PG		
	Programme Core for:		M.Sc. Physics
7.	Pre-requisite(s)		High Level Programming Language – C/C++/Fortran
8.	Status vis-à-vis other courses		
	8.1 List of courses precluded by taking this course (significant overlap)		
	(a)	Significant Overlap with any UG/PG course of the Dept./Centre/ School	NIL
	(b)	Significant Overlap with any UG/PG course of other Dept./Centre/ School	NIL
9.	Not allowed for		NIL
10.	Course offered in		Semester 2
11.	Faculty who will teach the course: Dr. Bhaskar Borah/Dr. Sweta Dabhi		
12.	Will the course require any visiting faculty?		No
13.	Course objectives "On successful completion of this course, a student should be able to apply various techniques to solve any physics problem. Students will understand how to solve a complex physics problem using computer tools"		
14.	Course contents: Errors in computation, Euler algorithm to solve ordinary differential equations: radioactive decay, air resistance, projectile motion, periodic motions; Verlet algorithm, Computing phase space trajectories of particle moving in various potential, i.e., harmonic oscillator, hard sphere, soft sphere; random number generators, proving central limit theorem, Monte Carlo methods of integration by rejection and importance sampling; curve fitting employing regression, Introduction to parallel programming, parallelizing the matrix multiplication program		
15.	Lecture Outline(with topics and number of lectures)		
	Module no.	Topic	No. of hours
	1	Errors in computation	4
	2	Euler algorithm to solve ordinary differential equations for radioactive decay, air resistance, projectile motion, periodic motions, Verlet algorithm, Computing phase space trajectories	2

		of particle moving in various potential, i.e., harmonic oscillator, hard sphere, soft sphere	
	3	random numbers and generators, proving central limit theorem	2
	4	Monte Carlo methods of integration by rejection and importance sampling	2
	5	Curve fitting	3
	6	Introduction to parallel programming	10
16.	Brief description of tutorial activities:		
	Module no.	Description	No. of hours
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	Total Tutorial hours		
17.	Brief description of Practical / Practice activities		
	Module no.	Description	No. of hours
	Module 2	Employ Euler and Verlet algorithm to solving physics problems	15
	Module 3	Write program for simple random number generator using linear congruence, test for randomness, prove central limit theorem	12
	Module 4	Calculation of value of pi, Monte Carlo integration of a given function using rejection technique, improving integration value by importance sampling	12
	Module 5	Curve fitting to data such as the binding energy curve	10
	Module 6	Parallelizing matrix multiplication	10
18.	Brief description of module-wise activities pertaining to self-learning component (Include topics that the students would do self-learning from books / resource materials: Do not Include assignments / term papers etc.)		
	Module no.	Description	
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19.	Suggested texts and reference materials STYLE: Author name and initials, Title, Edition, Publisher, Year		
	1. Computational Physics: An Introduction to Monte Carlo Simulations of Matrix Field Theory, Badis Ydri, https://arxiv.org/pdf/1506.02567.pdf 2. Computational Physics, J. M. Thijssen, Cambridge University Press		
20.	Resources required for the course (itemized student access requirements, if any)		
	20.1	Software	C/C++/Fortran compilers, Codeblock
	20.2	Hardware	Computers
	20.3	Teaching aids (videos, etc.)	Not as such
	20.4	Laboratory	Computer Laboratory
	20.5	Equipment	Computers
	20.6	Classroom infrastructure	Black board and projector
	20.7	Site visits	Not required

	20.8	Others (please specify)	None
21.	Design content of the course (Percent of student time with examples, if possible)		
	Design-type problems		NIL
	Open-ended problems		NIL
	Project-type activity		NIL
	¤ Open-ended laboratory work		NIL
	Others (please specify)		NIL