



# હેમચંદ્રાચાર્ય ઉત્તર ગુજરાત યુનિવર્સિટી

NAAC A (3.02) State University

પો.બો.નં.-૨૧, યુનિવર્સિટી રોડ, પાટણ (ઉ.ગુ.) ૩૮૪૨૬૫

ફોન:(૦૨૭૬૬) ૨૩૭૦૦૦

ફેક્સ : (૦૨૭૬૬) ૨૩૧૮૧૭

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## પરિપત્ર ક્રમાંક - ૨૨૫ / ૨૦૧૯

વિષય :- એમ.એસસી.- ફીઝીકસ વિષયના ઈલેક્ટીવ પેપરનાં અભ્યાસક્રમમાં ફેરફાર અંગે...

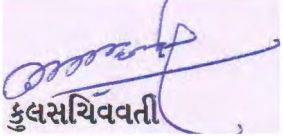
આ યુનિવર્સિટીના એમ.એસસી- ફીઝીકસ વિભાગના કો. ઓર્ડીનેટરશ્રીને તથા સંલગ્ન સાયંસ કોલેજોના આચાર્યશ્રીઓને જણાવવાનું કે, વિજ્ઞાન વિદ્યાશાખામાં એમ.એસસી - ફીઝીકસ વિષયના ઈલેક્ટીવ પેપરનાં બે ક્રેડીટ વેઈટેજ ધરાવતા વિષયમાં ૫૦ ગુણનું વિભાજન ૩૫ ગુણ યુનિવર્સિટી પરીક્ષાના અને ૧૫ ગુણ આંતરીક પરીક્ષાના તે મુજબનાં ફેરફાર કરી અભ્યાસ સમિતિના ચેરમેનશ્રીએ રજૂ કરેલ સામેલ પરિશિષ્ટ મુજબનો સુધારેલ અભ્યાસક્રમ જૂન-૨૦૧૯ થી ક્રમશઃ અમલમાં આવે તે રીતે એકેડેમિક કાઉન્સિલવતી માન.કુલપતિશ્રીએ મંજૂર કરેલ છે. જેનો અમલ થવા સારૂ સંબંધિતોને આથી આ સાથે મોકલવામાં આવે છે.

આ બાબતની સંબંધિતોને આપના સ્તરેથી જાણ કરવા વિનંતી છે.

નોંધ: (૧) વિદ્યાર્થીઓની જરૂરીયાત માટે પરિપત્રની એક નકલ વિભાગ / કોલેજોના ગ્રંથાલયમાં મૂકવાની રહેશે.

(૨) આ પરિપત્ર યુનિવર્સિટીની વેબ સાઈટ www.ngu.ac.in પર પણ ઉપલબ્ધ કરાવવામાં આવનાર છે.

બિડાણ : ઉપર મુજબ

  
કુલસચિવવતી

નં.-એ કે/અ સ/૬૨૫૪ / ૨૦૧૯

તારીખ: ૦૬ / ૧૦ / ૨૦૧૯

પ્રતિ

૧. અધ્યક્ષશ્રી/ કો.ઓર્ડીનેટરશ્રી-વિજ્ઞાન વિદ્યાશાખા અંતર્ગત વિષયોના અનુસ્નાતક વિભાગો, હેમ. ઉ.ગુ. યુનિવર્સિટી, પાટણ.
૨. સંલગ્ન સાયંસ કોલેજોના આચાર્યશ્રીઓ
૩. ડૉ. એમ. બી. પ્રજાપતિ (ડીનશ્રી), ગણિતશાસ્ત્ર ભવન, હેમ. ઉ.ગુ. યુનિવર્સિટી, પાટણ.
૪. પરીક્ષા નિયામકશ્રી, હેમચંદ્રાચાર્ય ઉત્તર ગુજરાત યુનિવર્સિટી, પાટણ. (બે નકલ)
૫. ગ્રંથપાલશ્રી, હેમ.ઉત્તર ગુજરાત યુનિવર્સિટી, પાટણ. (વિદ્યાર્થીઓના ઉપયોગ સારૂ રેકર્ડ ફાઈલ માટે)
૬. સિસ્ટમ એનાલીસ્ટશ્રી, કોમ્પ્યુટર (રીઝલ્ટ) સેન્ટર, હેમ.ઉ.ગુ.યુનિવર્સિટી, પાટણ. તરફ પરિણામ માટે તથા વેબસાઈટ પર મૂકવા સારૂ.
૭. મુખ્ય હિસાબી અધિકારીશ્રી (મહેકમ), હેમચંદ્રાચાર્ય ઉત્તર ગુજરાત યુનિવર્સિટી, પાટણ તરફ → પરિપત્રની ફાઈલ અર્થે
૮. સિલેક્ટ ફાઈલે. (૨ નકલ)



# હેમચંદ્રાચાર્ય ઉત્તર ગુજરાત યુનિવર્સિટી

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પો.બો.નં.-૨૧, યુનિવર્સિટી રોડ, પાટણ (ઉ.ગુ.) ૩૮૪૨૬૫

ફોન: (૦૨૭૬૬) ૨૨૨૭૪૫, ૨૩૦૫૨૯, ૨૩૦૭૪૩, ૨૩૩૬૪૮

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## પરિપત્ર ક્રમાંક - ૪૪/૨૦૧૯

વિષય: વિજ્ઞાન વિદ્યાશાખાના અનુસ્નાતક કક્ષાના સેમેસ્ટર-૧ થી સેમેસ્ટર-૪ સુધીના નવા અભ્યાસક્રમોનું માળખું તેમજ નવા અભ્યાસક્રમ અંગે...

આ યુનિવર્સિટીના વિજ્ઞાન વિદ્યાશાખા અંતર્ગત વિષયોના અનુસ્નાતક વિભાગો તથા સંલગ્ન વિજ્ઞાન વિદ્યાશાખાની તમામ કોલેજોના આચાર્યશ્રીઓને જણાવવાનું કે, એકેડેમીક કાઉન્સિલ ની તા. ૫/૬/૨૦૧૯ ની સભા ના નિર્દિષ્ટ ઠરાવો અન્વયે UGC ની Model curriculum અંગેની Guideline સંદર્ભે વિજ્ઞાન વિદ્યાશાખા હેઠળના નીચેના વિષયોના અનુસ્નાતક કક્ષાના સામેલ પરિશિષ્ટ પ્રમાણેના નવા અભ્યાસક્રમનું માળખું તેમજ અભ્યાસક્રમો **શૈક્ષણિક વર્ષ: ૨૦૧૯-૨૦ થી ક્રમશઃ અમલ માં આવે તે રીતે** મંજૂર કરેલ છે. જેનો અમલ કરવા સારૂ સંબંધિતોને આ સાથે મોકલવામાં આવે છે.

ક્રમ નં.	અભ્યાસક્રમ	એકેડેમીક કાઉન્સિલની તારીખ: ૦૫/૦૬/૨૦૧૯ના ઠરાવ ક્રમાંક	સેમેસ્ટર
૧	અભ્યાસક્રમો નું માળખું	૦૭	તમામ સેમેસ્ટર
૨	રસાયણશાસ્ત્ર	૪૪	સેમ.-૧ થી સેમ.-૨
૩	પ્રાણીશાસ્ત્ર	૪૫	સેમ.-૧ થી સેમ.-૪
૪	બાયોટેકનોલોજી	૪૬	સેમ.-૧ થી સેમ.-૪
૫	ગણિતશાસ્ત્ર	૪૭	સેમ.-૧ થી સેમ.-૪
૬	એમ.એસ.સી. ઈલેક્ટ્રોનિક્સ	૪૯	સેમ.-૧ થી સેમ.-૪
૭	ભૌતિકશાસ્ત્ર	૫૦	સેમ.-૧ થી સેમ.-૪

આ બાબતની સંબંધિત અધ્યાપકો તથા વિદ્યાર્થીઓને આપના સ્તરેથી જાણ કરવા વિનંતી છે.

નોંધ :- (૧) વિદ્યાર્થીઓની જરૂરીયાત માટે પરિપત્રની એક નકલ કોલેજના ગ્રંથાલયમાં મૂકવાની રહેશે.

(૨) આ અભ્યાસક્રમ / સ્કીમ યુનિવર્સિટીની વેબ સાઈટ [www.ngu.ac.in](http://www.ngu.ac.in) પર પણ ઉપલબ્ધ કરાવવામાં આવનાર છે.

બિડાણ : ઉપર મુજબ

સહી/-  
કુલસચિવવતી

નં.-એ કે / અ× સ / ૧૦૧૬૩ / ૨૦૧૯

તારીખ : ૧૪ / ૦૩ / ૨૦૧૯

પ્રતિ,

૧. અધ્યક્ષશ્રી/ કો.ઓર્ડીનેટરશ્રી-વિજ્ઞાન વિદ્યાશાખા અંતર્ગત વિષયોના અનુસ્નાતક વિભાગો, હેમ. ઉ.ગુ. યુનિવર્સિટી, પાટણ.

૨. સંલગ્ન સાયન્સ કોલેજોના આચાર્યશ્રીઓ

૩. ડૉ. એમ. બી. પ્રજાપતિ (ડીનશ્રી), ગણિતશાસ્ત્ર ભવન, હેમ. ઉ.ગુ. યુનિવર્સિટી, પાટણ.

૪. પરીક્ષા નિયામકશ્રી, હેમચંદ્રાચાર્ય ઉત્તર ગુજરાત યુનિવર્સિટી, પાટણ. (પાંચ નકલ)

૫. ગ્રંથપાલશ્રી, હેમ.ઉત્તર ગુજરાત યુનિવર્સિટી, પાટણ. (વિદ્યાર્થીઓના ઉપયોગ સારૂ રેકર્ડ ફાઈલ માટે)

૬. સિસ્ટમ એનાલીસ્ટશ્રી, કોમ્પ્યુટર (રીઝલ્ટ) સેન્ટર, હેમ.ઉ.ગુ.યુનિવર્સિટી, પાટણ. તરફ પરિણામ માટે તથા વેબસાઈટ પર મૂકવા સારૂ.

૭. માન.કુલપતિશ્રી/ કુલસચિવશ્રીનું કાર્યાલય, હેમ.ઉત્તર ગુજરાત યુનિવર્સિટી, પાટણ.

૮. અનુસ્નાતક પ્રશાખા (એકેડેમીક શાખા) હેમચંદ્રાચાર્ય ઉત્તર ગુજરાત યુનિવર્સિટી, પાટણ.

૯. મુખ્ય હિસાબી અધિકારીશ્રી (મહેકમ), હેમચંદ્રાચાર્ય ઉત્તર ગુજરાત યુનિવર્સિટી, પાટણ તરફ → પરિપત્રની ફાઈલ અર્થે

૧૦. સિલેક્ટ ફાઈલે. (૨ નકલ)

**HEMCHANDRACHARYA NORTH GUJARAT  
UNIVERSITY, PATAN**

**M.Sc. (Physics) CBCS Syllabus 2019**

<b>Document code</b>	<b>SYLLABUS MSPHY2019</b>
<b>Revision No.</b>	<b>00</b>
<b>Name of Faculty</b>	<b>SCIENCE</b>
<b>Faculty Code</b>	<b>SC</b>
<b>Program Name</b>	<b>MASTER OF SCIENCE (PHYSICS)</b>
<b>Program Code</b>	<b>MSPHY</b>
<b>Effective from</b>	<b>June 2019</b>

# HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

The proposed New Course in M.Sc. PHYSI CS PROGRAM is based on Choice Based Credit System (CBCS) which is in force from June-2019.

## CBCS Course Pattern

1. This Program is divided into four Semesters (Two Years). The duration of an academic year consists of two semesters, each of 15 weeks for teaching. The academic session in each semester will provide 90 teaching days. 24 credit each semester X 4 semester = 96 credits at master level.
2. There will be three categories of courses/papers in this Program:
  - A. FOUR Compulsory-Core theory courses with 4 credits each in first three semesters and Three Compulsory-Core theory courses with 4 credits each in Semester IV.
  - B. One Choice Based Elective Course (disciplinary/interdisciplinary) with 2 credits in First Three semesters.
  - C. One Practical course (PR) with 6 credits in first three semesters.
  - D. In Semester IV, instead of practical there is a project/field work with 12 - credits.
3. Detailed Course Pattern for each Semester is given below.

The Proposed New Structure for M.Sc. Course is based on choice Based Credit System (CBCS) which is in force from June – 2019.

### M.Sc.: Semester – I

Course	Name of the Course	Exam. Duration (Hours)	Ext. Marks	Int. Marks	Total Marks	Teach, Hours Per week	Credit point
Paper – I	Core-I	2 : 30	70	30	100	4	4
Paper – II	Core-II	2 : 30	70	30	100	4	4
Paper – III	Core-III	2 : 30	70	30	100	4	4
Paper – IV	Core-IV	2 : 30	70	30	100	4	4
Practical : Paper – I	Pract-I	3	75	--	75	6	3
Practical : Paper – II	Pract-II	3	75	--	75	6	3
Elective Course (Any One) Disciplinary/ Interdisciplinary		2 : 00	35	15	50	2	2
<b>TOTAL</b>			465	135	600	30	24

### M.Sc.: Semester – II

Course	Name of the Course	Exam. Duration (Hours)	Ext. Marks	Int. Marks	Total Marks	Teach, Hours Per week	Credit point
Paper – V	Core-V	2 : 30	70	30	100	4	4
Paper – VI	Core-VI	2 : 30	70	30	100	4	4
Paper – VII	Core-VII	2 : 30	70	30	100	4	4
Paper – VIII	Core-VIII	2 : 30	70	30	100	4	4
Practical : Paper – III	Pract-III	3	75	--	75	6	3
Practical : Paper – IV	Pract-IV	3	75	--	75	6	3
Elective Course (Any One) Disciplinary / Interdisciplinary		2 : 00	35	15	50	2	2
<b>TOTAL</b>			465	135	600	30	24



**M.Sc.: Semester – III**

Course	Name of the Course	Exam. Duration (Hours)	Ext. Marks	Int. Marks	Total Marks	Teach, Hours Per week	Credit point
Paper – IX	Core-IX	2 : 30	70	30	100	4	4
Paper – X	Core-X	2 : 30	70	30	100	4	4
Paper – XI	Core-XI	2 : 30	70	30	100	4	4
Paper – XII	Pract-XII	2 : 30	70	30	100	4	4
Practical : Paper – V	Pract-V	3	75	--	75	6	3
Practical : Paper – VI	Pract-VI	3	75	–	75	6	3
Elective Course (Any One) Disciplinary / Interdisciplinary		2 : 00	35	15	50	2	2
<b>TOTAL</b>			465	135	600	30	24

**M.Sc.: Semester – IV**

Course	Name of the Course	Exam. Duration (Hours)	Ext. Marks	Int. Marks	Total Marks	Teach, Hours Per week	Credit point
Paper – XIII	Core-X	2 : 30	70	30	100	4	4
Paper – IX	Core-XI	2 : 30	70	30	100	4	4
Paper – XV	Core-XII	2 : 30	70	30	100	4	4
Project	PROJECT	4	210	90	300	18	12
<b>TOTAL</b>			420	180	600	30	24

**NOTE:**

1. For 4 credit course: Each syllabus is of 4 Units having equal weightage.
2. For 2 credit course: Each syllabus is of 2 Units having equal weightage.
3. There is no section in semester end examinations i.e. questions Paper is without sections.
4. For question paper of 70 marks: Each Question paper contains 4 questions: Q-1 from unit-I of 18 marks, Q-2 from unit-II of 17 marks, Q-3 from unit-III of 18 marks and Q-4 from unit – IV of 17 marks.
5. For question paper of 35 marks: Each Question paper contains 3 questions: Q-1 from unit-I of 12 marks, Q-2 from unit-II of 12 marks, and last Q-3 is of short questions and objective types having 11 marks from unit I and unit II.



Sem	Paper Code	Paper Type	Paper Name	Marking scheme				Credit	Total	Remarks
				External		Internal				
				The	Pra	The	Pra			
1	MSPHY101CC	CC	MATHEMATICAL PHYSICS-1 AND "C" PROGRAMMING-1	70		30		4	100	
1	MSPHY102CC	CC	CLASSICAL MECHANICS-1 AND ELECTRODYNAMICS-1	70		30		4	100	
1	MSPHY103CC	CC	QUANTUM MECHANICS-1 AND SOLID STATE PHYSICS-1	70		30		4	100	
1	MSPHY104CC	CC	ELECTRONICS-1	70		30		4	100	
1		PRACT			150			6	150	
1	MSPHY101ES	ES	SPACE PHYSICS	35		15		2	50	Any one from Two ES PAPER
1	MSPHY102ES	ES	ENERGY TECHNOLOGY AND STORAGE SYSTEMS (ETS)	35		15		2	50	

Sem	Paper Code	Paper Type	Paper Name	Marking scheme				Credit	Total	Remarks
				External		Internal				
				The	Pra	The	Pra			
2	MSPHY201ES	CC	MATHEMATICAL PHYSICS-2 AND "C" PROGRAMMING-2	70		30		4	100	
2	MSPHY202CC	CC	STATISTICAL MECHANICS-1 COMPUTER-1	70		30		4	100	
2	MSPHY203CC	CC	QUANTUM MECHANICS-2 AND SOLID STATE PHYSICS-2	70		30		4	100	
2	MSPHY204CC	CC	ELECTRONICS-2	70		30		4	100	
2		PRACT			150			6		
2	MSPHY201ES	ES	APPLICATION OF COMPUTER IN PHYSICS	35		15		2	50	Any one from Two ES PAPER
2	MSPHY201ES	ES	SYNTHESIS OF MATERIALS	35		15		2	50	



Sem	Paper Code	Paper Type	Paper Name	Marking scheme				Credit	Total	Remarks
				External		Internal				
				The	Pra	The	Pra			
3	MSPHY301CC	CC	NUCLEAR PHYSICS-1 INSTRUMENTS	70		30		4	100	
3	MSPHY302CC	CC	STATISTICAL MECHANICS-2 COMPUTOR-2	70		30		4	100	
3	MSPHY303CC	CC	QUANTUM MECHANICS-3 SOLID STATE PHYSICS-3,	70		30		4	100	
3	MSPHY304CC	CC	ELECTRONICS-3	70		30		4	100	
3		PRACT			150			6	150	
3	MSPHY301ES	ES	RESEARCH METHODOLOGY	35		15		2	50	Any one from Two ES PAPER
3	MSPHY301 ES	ES	MICROCONTROLLER	35		15		2	50	

Sem	Paper Code	Paper Type	Paper Name	Marking scheme				Credit	Total	Remarks
				External		Internal				
				The	Pra	The	Pra			
4	MSPHY401CC	CC	NUCLEAR PHYSICS-2 BIO- PHYSICS	70		30		4	100	
4	MSPHY402CC	CC	CLASSICAL MECHANICS-2 ELECTRODYNEMICS-2	70		30		4	100	
4	MSPHY403CC	CC	QUANTUM MECHANICS-4 SOLID STATE PHYSICS-4,	70		30		4	100	
4		PR		210		90		12	300	

## PATTERN/SCHEME OF EXAMINATION

There will be examinations at the end of each semester ordinarily during November / December for odd semesters and during April/May for even semesters.

### Theory Examinations:

Out of the total marks for each course/paper maximum 30% marks shall be earmarked for Internal Exam. (Through continuous internal evaluation process) and remaining 70% for External Exam. (Through semester-end examinations).

There will be one semester-end examination of two hours and thirty minutes duration for core theory papers and two hours for elective papers. Each answer script of semester end examination (theory) will be evaluated by internal as well as external examiner.

The passing marks in each paper shall be 40%.

### PRACTICAL EXAMINATION:

In the case of science faculty, there will be a practical examination at the end of every semester. There will be **TWO** Practical (one from each groups) (75Marks each for Sem.-I to Sem.-III) in the Exam. The passing marks for practical will be 40%. The practical examinations shall be conducted with one internal and one external examiner.

In 4th Semester one minor project work there will be of 300 marks. Assessment method is given below.

**Project Report (70 Marks):** Aims & Objectives-Clearly stated and achieved? Layout, Writing style, quality of Figures, Tables, Proper organization of work etc. Use of Lib./Int./Ref.: Literature review, survey, referencing etc

**Presentation (70 Marks):** Way of presentation, quality of presentation, Language, clarity of speech, Method of analysis, conclusion and Recommendations, Discussion of work etc.

**Viva-Voce (70 Marks):** ability to answer queries and question.

There will be no internal assessment test for practical, and Elective courses in first three semester but in fourth semester there will be internal assessment for Project work .

### INTERNAL ASSESSMENT

For each paper/course in a semester there will be Continuous internal evaluation process which includes

- Unit Test / Internal Test
- MCQ Test / QUIZ Test/Viva
- Seminar/ Poster Presentation/ Assignment work/Workshop
- Attendance - Regularity & Study Tour
- Library work -Book Review



## STRUCTURE OF THE PAPER IN EXAMINATION

### For Core Courses (Disciplinary/Interdisciplinary):

There will be total four questions. First question will be from Unit - I, Second question from Unit-II, Third question from Unit-III, and fourth question will be from Unit -4. All the questions are detailed as under. (Total 70 Marks and 2 Hours thirty minutes time for the Paper)

1	(a) Answer the following. (Any one out of two) (Theory questions)	8 Marks
1	(b) Answer the following. (Any two out of three) (application/ Problem/ example type )	8 Marks
1	(c) Answer the following. (Any one out of two or Any Two out of three) (Short answer questions / objective type questions)	2 Marks
2	(a) Answer the following. (Any one out of two) (Theory questions)	7 Marks
2	(b) Answer the following. (Any two out of three) (application/ Problem/ example type )	8 Marks
2	(c) Answer the following. (Any one out of two or Any Two out of three) (Short answer questions / objective type questions)	2 Marks
3	(a) Answer the following. (Any one out of two) (Theory questions)	8 Marks
3	(b) Answer the following. (Any two out of three) (application/ Problem/ example type )	8 Marks
3	(c) Answer the following. (Any one out of two or Any Two out of three) (Short answer questions / objective type questions)	2 Marks
4	(a) Answer the following. (Any one out of two) (Theory questions)	7 Marks
4	(b) Answer the following. (Any two out of three) (application/ Problem/ example type )	8 Marks
4	(c) Answer the following. (Any one out of two or Any Two out of three) (Short answer questions / objective type questions)	2 Marks

### For Elective Courses (Disciplinary/Interdisciplinary):

There will be three questions first and second questions are of 12 marks each and third question is of 11marks. First question will be from Unit - I, Second question from Unit-II, Third question will be from both Units. All the questions are detailed as under. (Total 35 Marks and 2 Hours' time for the Paper)

1	(a) Answer the following (Any one out of two) (Theory questions)	6 Marks
	(b) Answer the following (Any two out of three) (short note/ application/ Problem/ example type )	6 Marks
2	(a) Answer the following (Any one out of two) (Theory questions)	6 Marks
	(b) Answer the following (Any two out of three) (short note/ application/ Problem/ example type )	6 Marks
3	(a) Answer any three out of five.(Short question)	6 Marks
	(b) Answer any five out of eight.(objective)	5 Marks

**DETAILED CURRICULMSUMMARY IS GIVENIN FOLLOWING TABLE.**

SEM	PAPER CODE	PAPER NAME	UNIT	TITLE OF UNIT
I	MSPHY-101CC	MATHEMATICAL PHYSICS -1 AND PROGRAMMING IN C-1	I	FUNCTION OF A COMPLEX VARIABLE
			II	INTEGRALTRANSFORMS
			III	DECISION MAKING AND LOOPING & ARRAYS
			IV	CHARACTER ARRAYS AND STRINGS &FUNCTIONS
I	MSPHY-102CC	CLASSICAL MECHANICS-1 ELECTRODYNAMICS -1	I	CANONICAL TRANSFORMATION
			II	SMALL OSCILLATION AND ROTATING FRAME
			III	ELECTOMAGNETIC WAVES
			IV	POYNTING VECTOR AND THE FLOW OF POWER&GUIDED WAVES:
I	MSPHY-103CC	QUANTUM MECHANICS – ISOLID STATE PHYSICS-I	I	REPRESENTATION OF QUANTUM STATES
			II	ANGULAR MOMENTUM
			III	ENERGY BANDS
			IV	SEMICONDUCTOR CRYSTALS
I	MSPHY-104CC	ELECTRONICS-1	I	FETAMPLIFIER&MULTIVIBRATORS
			II	POWER AMPLIFIER
			III	WAVE SHAPING CIRCUIT
			IV	IC FABRICATION & TIMER 555 IC
I	MSPHY-101ES	SPACE PHYSICS	I	BASIC CONCEPTS OF EARTH’S ATMOSPHERE AND IONOSPHERE
			II	AURORA , AIRGLOW, AND MAGNETOSPHERE
I	MSPHY-102ES	ENERGY TECHNOLOGY AND STORAGE SYSTEMS	I	ENERGY TECHNOLOGY
			II	ENERGY STORAGE SYSTEMS

SEM	PAPER CODE	PAPER NAME	UNIT	TITLE OF UNIT
II	MSPHY-201CC	MATHEMATICAL PHYSICS -2 AND PROGRAMMING IN C-2	I	TENSOR ANALYSIS
			II	GROUP THEORY
			III	STRUCTURES AND UNIONS & POINTER
			IV	FILE MANAGEMENT IN C:&DEVELOPING A C PROGRAM
II	MSPHY-202CC	STATISTICAL MECHANICS-1 COMPUTER-1	I	BASIC CONCEPT IN STATISTICAL MECHANICS AND QUANTUM STATISTICS
			II	IDEAL BOSE AND FERMI SYSTEM
			III	WINDOWS AND POWER POINT
			IV	MICRO-SOFT WORD
II	MSPHY-203CC	QUANTUM MECHANICS–2 SOLID STATE PHYSICS-2	I	APPROXIMATION METHODS FOR STATIONARY STATES:
			II	EVOLUTION WITH TIME
			III	FERMI SURFACES AND METALS
			IV	DIAMAGNETISM AND PARAMAGNETISM
II	MSPHY-204CC	ELECTRONICS-2	I	OPERATIONAL AMPLIFIER
			II	DIGITAL ELECTRONICS
			III	MICROPROCESSOR – I
			IV	MICROPROCESSOR –II
II	MSPHY-201ES	APPLICATIONS OF COMPUTER IN PHYSICS	I	
			II	
II	MSPHY-202ES	SYNTHESIS OF MATERIAL	I	
			II	

SEM	PAPER CODE	PAPER NAME	UNIT	TITLE OF UNIT
III	MSPHY-301CC	NUCLEAR PHYSICS-1 AND INSTRUMENTS	I	TWO BODY FORCES
			II	NUCLEAR REACTION
			III	MICROSCOPY
			IV	UV-VIS
III	MSPHY-302CC	STATISTICAL MECHANICS-2 COMPUTER-2	I	PHASE EQUILIBRIA
			II	TRANSPORT PHENOMENA
			III	MICRO-SOFT EXCEL
			IV	COMPUTER NETWORK,INTERNET AND VIRUS
III	MSPHY-303CC	QUANTUM MECHANICS-3 SOLID STATE PHYSICS-3	I	SCATTERING THEORY
			II	PARTIAL WAVE ANALYSIS
			III	FERROMAGNETISM AND ANTI FERROMAGNETISM
			IV	MAGNETIC RESONANCE
III	MSPHY-304CC	ELECTRONICS	I	PULSE MODULATION AND DIGITAL COMMUNICATION
			II	DEMODULATION
			III	REMOTE SENSING
			IV	POWER ELECTRONICS
III	MSPHY-301ES	RESEARCH METHODOLOGY	I	
			II	
III	MSPHY-302ES	MICROCONTROLLER	I	
			II	

SEM	PAPER CODE	PAPER NAME	UNIT	TITLE OF UNIT
IV	MSPHY-401CC	NUCLEAR PHYSICS-2 AND BIO-PHYSICS	I	NUCLEAR MODEL
			II	ELEMENTARY PARTICLE
			III	SEPARATION TECHNIQUES
			IV	BIO-MECHANICS
IV	MSPHY-402CC	CLASSICAL MECHANICS-2 ELECTRODYNAMICS -2	I	NON LINEAR OSCILLATIONS AND CHAOS
			II	RELATIVISTIC ELECTRODYNAMICS
			III	WAVE GUIDE
			IV	RADIATION
IV	MSPHY-403CC	QUANTUM MECHANICS-4 SOLID STATE PHYSICS-4	I	RELATIVISTIC WAVE EQATIONS-1
			II	RELATIVISTIC WAVE EQATIONS-2
			III	OPTICAL PROCESSES AND EXCITONS
			IV	SOLAR CELL AND OPTO ELECTRONIC DEVICES
IV		PROJECT		



HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN				
PROGRAM CODE	MSPHY	PROGRAM NAME		M.SC.PHYSICS
COURSE CODE	MSPHY 301 CC	SEMESTER		3
<b>NUCLEAR PHYSICS-1 AND INSTRUMENTS</b>				
COURSE TYPE	CORE COMPULSORY	TOTAL CREDIT:	04	
TEACHING TIME (HOURS)	<b>EXAMINATION MARKING SCHEME</b>			
THEORY (HRS)	PRACTICAL (MARKS)	INTERNAL (MARKS)	EXTERNAL (MARKS)	TOTAL (MARKS)
4 X 15 = 60	-	30	70 (2.5 HRS)	100

#### UNIT-I

##### NUCLEAR PROPERTIES:

Nuclear spin, electric moments, magnetic moments, a brief description of hyperfine structure of atomic spectra, effect of an external magnetic field on the hyperfine structure, determination of  $I$  from molecular band spectra, molecular beam resonance method – experiments on hydrogen and deuterium.

##### TWO-BODY FORCES:

Deuteron. Excited states of the deuteron, neutron proton scattering at low energies, scattering length, spin dependence of neutron proton scattering, singlet state in n-p system, effective range theory in n-p scattering, tensor forces, magnetic moment and electric quadrupole moment of the deuteron, proton proton scattering at low energy, exchange forces, meson theory of nuclear forces.

#### UNIT-II

##### NUCLEAR REACTIONS:

Nuclear reactions and cross sections, Resonance: Breit Wigner dispersion formula for  $l = 0$ , The compound nucleus, Continuum theory of nuclear reaction, Direct reactions, Theory of stripping reactions - semi classical description and wave mechanical description.

#### UNIT-III

##### MICROSCOPY:

##### Scanning Electron Microscopy (SEM)

Physical Basis and Primary Modes of Operation, Instrumentation, Sample Requirements, FESEM, Advantages over conventional SEM, Applications

##### Transmission Electron Microscopy (TEM)

Basic Principle, Resolution, Sensitivity, TEM Operation, Image Mode, Specimen Preparation

##### Scanning Tunneling Microscopy (STM) and Scanning Force Microscopy (SFM)

Introduction, Instrumentation, Topography, Profilometry, Sample Requirements

#### UNIT-IV

##### UV-VIS:

Introduction, principle of UV-vis spectroscopy, Beer-Lambert's law, molar absorptivity, absorbing species, containing  $\pi$ ,  $\sigma$  and  $\eta$  electrons, charge transfer absorption, Instrumentation of UV-vis spectroscopy: Radiation Sources, Wavelength Selectors, Monochromators, Sample Handling, Detectors, Signal Processing and Output Devices, Types of UV-Visible Spectrometers: Single Beam Spectrometers, Double Beam Spectrometers, Photodiode Array Spectrometer, applications.

##### REFERENCE BOOK:

1. Introduction to Nuclear physics Theory and Experiment by R.R.ROY and B.P.Nigam
2. Introduction to Nuclear physics, H.A. Engle
3. Nuclear physics by D.C.Tayal
4. Nuclear physics by IRVING KAPLAN

5. Introduction to nuclear physics an introduction by S.B.Patel, New Age International Publishers
6. Scanning Electron Microscopy, X-Ray Microanalysis, and Analytical Electron microscopy, A Laboratory Workbook, Patrick Echlin, Alton D. Romig Jr., Gwyn Williams
7. Elementary Organic Spectroscopy, Y R Sharma S. Chand.
8. Molecular Structure and Spectroscopy, G Aruldhas PHI publisher.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN				
PROGRAM CODE	MSPHY	PROGRAM NAME		M.SC.PHYSICS
COURSE CODE	MSPHY 302 CC	SEMESTER		3
<b>STATISTICAL MECHANICS-2 AND COMPUTER-2</b>				
COURSE TYPE	CORE COMPULSORY	TOTAL CREDIT:	04	
TEACHING TIME (HOURS)	<b>EXAMINATION MARKING SCHEME</b>			
THEORY (HRS)	PRACTICAL (MARKS)	INTERNAL (MARKS)	EXTERNAL (MARKS)	TOTAL (MARKS)
4 X 15 = 60	-	30	70 (2.5 HRS)	100

#### UNIT-I

##### PHASE EQUILIBRIA:

Equilibrium conditions, classification of phase transitions, phase diagram, Clausius-Clapeyron equation, Critical exponents, Van der Waal equations, second order phase transitions, Ginzburg-Landau theory, phase transition in ferromagnetic materials, liquid helium, Curie - Weiss theory of Magnetic transition, Ising Model, Ising Model in zeroth approximation, Exact solution of one dimensional Ising Model, Order parameters

#### UNIT-II

##### TRANSPORT PHENOMENA:

Mean collision time, Thermionic emission, Photoelectric effect, Molecular collisions, Effusion, Einstein relation for mobility, Distribution function, Boltzmann transport equation, Relaxation approximation, Boltzmann H-theorem, Maxwell-Boltzmann distribution from Boltzmann equation. Boltzmann H-theorem in Q.M.

#### UNIT-III

##### MICRO-SOFT EXCEL :

Introduction to spreadsheets, Use of spreadsheets, spreadsheets basics, Labels, Values and Functions, Formula, Functions, What-if analysis, Automatic recalculation, formatting spreadsheet, graphs.

**Introduction to Excel :** Functions of Microsoft Excel, starting ms-excel, Excel work environment, changing the size of work book and excel window, Cell and Cell address, Standard toolbar, Formatting toolbar, the formula bar, status bar, Components of an excel workbook, quitting ms-excel

**Working in Excel :** Moving inside a workbook, Moving the cell pointer quickly, Selecting a command, types of data, Entering data at cell address, Making changes to an entry, saving your workbook, closing the workbook, quitting ms-excel

**Mathematical Calculations:** Formulas using numbers, Formulas using cell address, Opening ms-excel and entering data, Defining functions, writing a function, Common excel functions

**Manipulating data:** Moving data, Copying data, Relative cell addressing, absolute cell addressing, Copying values, not formula or function, deleting rows and columns, Deleting contents of a row, Inserting rows, inserting columns, Automatic filling of entries, quitting ms-excel

**Changing the layout:** Aligning data, Increasing or decreasing the column width, Increasing or decreasing the height of rows, Erasing the contents of a sheet, Deleting data from the cell address, Setting column width to zero, Values formatting, Points to remember, Closing workbook and quitting excel

**Simple Graphs:** Drawing a graph, Naming the sheet, saving the workbook, printing and closing a graphic sheet, opening the saved graphic sheet, quitting ms-excel

**Manipulating Sheets:** Adding sheet to a workbook, Adding many sheet to a workbook, renaming a sheet and entering data in it, Moving sheet, Copying data between sheets, Protecting the workbook, Deleting a sheet from a workbook, Saving the workbook automatically, Closing the workbook, recovering the deleted workbook, quitting ms-excel.



#### **UNIT-IV**

##### **COMPUTER NETWORK, INTERNET AND VIRUS:**

Local Area Network(LAN), Metropolitan Area Network(MAN) Wide Area Network(WAN), Routing, Network topology.

Use of Internet, Web Browser, Search Engine, Surfing, Mail(Draft,Send, Receive, Delete), TCP/IP, Uniform resource locator (URL), Internet service provider, Internet security, surfing.

Introduction to computer viruses, What is virus?, Classification of viruses, Latest known viruses, virus prevention, Anti virus.

##### **REFERENCE BOOKS:**

1. Fundamentals of statistical mechanics by B. B. Laud, 1998, New age international (P) LTD, Publishers, New Delhi. basic reference
2. Statistical Mechanics and Properties of Matter by E.S. Raja Gopal, Mc Millan Company of India Limited.
3. Statistical Mechanics - An Introduction by Evelyn Guha, Narosa Publishing House
4. Statistical Mechanics by R.K. Patharia, Pergamon Press
5. Fundamentals of Statistical Mechanics by F. Reif, Mc Graw Hill Companies
6. Statistical Mechanics - Theory and Applications by S.K. Sinha, Narosa Publishing House, New Delhi.
7. IT Tools and Applications by R.K. Taxali.
8. Comdex Computer Course Kit by Vikas Gupta, Publisher: Dreamtechl.
9. Microsoft Office 2000 Complete by Sybex, BPB Publication.
10. Peter Norton Complete Guide to Microsoft Office 2000 by Wayne S. Freeze, BPB Publication.
11. Fundamental of Information technology by: Deepak Bharihoke

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN				
PROGRAM CODE	MSPHY	PROGRAM NAME		M.SC.PHYSICS
COURSE CODE	MSPHY 303 CC	SEMESTER		3
<b>QUANTUM MECHANICS-3 AND SOLID STATE PHYSICS-3</b>				
COURSE TYPE	CORE COMPULSORY	TOTAL CREDIT:	04	
TEACHING TIME (HOURS)	<b>EXAMINATION MARKING SCHEME</b>			
THEORY (HRS)	PRACTICAL (MARKS)	INTERNAL (MARKS)	EXTERNAL (MARKS)	TOTAL (MARKS)
4 X 15 = 60	-	30	70 (2.5 HRS)	100

#### UNIT-I

##### SCATTERING THEORY:

The scattering cross-section. General considerations : Kinematics of scattering process; Differential and Total crosssections, Wave mechanical picture of scattering: The scattering amplitude, Green functions : Formal expression for scattering Amplitude, The Born and Eikonal Approximations : The Born Approximation, The validity of the Born Approximation, The Born series, The Eikonal Approximation.

#### UNIT – II

##### PARTIAL WAVE ANALYSIS :

Asymptotic Behaviour of partial waves : phase shift, The scattering Amplitude in terms of phaseshifts, The Differential and Total cross-sections, Optical Theorem , Phase shift: relation to the potentials, Potentials of finite range, Low energy scattering, Exact soluble problems, Scattering by a square well, scattering by a hard sphere, scattering by a coulomb potential mutual scattering of two particles , Reduction of the two body problem : The center of mass frame , Transformation from centre of mass to Laboratory frame of reference , collisions between identical particles.

#### UNIT-III

##### FERROMAGNETISM AND ANTI FERROMAGNETISM:

Ferromagnetic Order, Curie Point and the Exchange Integral, Temperature Dependence of the Saturation, Magnetization, Saturation Magnetization at Absolute Zero, Magnons, Quantization of Spin Wave, Thermal Excitation of Magnons, Neutron Magnetic Scattering, Ferrimagnetic Order, Curie Temperature and Susceptibility of Ferrimagnets, Iron Garnets, Anti ferromagnetic Order, Susceptibility Below the Neel Temperature, Anti ferromagnetic Magnons, Ferromagnetic Domains, Anisotropy Energy, Transition Region between Domains, Origin of Domains, Coercivity and Hysteresis, Single Domain Particles, Geomagnetism and Biomagnetism, Magnetic Force Microscopy

#### UNIT-IV

##### MAGNETIC RESONANCE:

Nuclear Magnetic Resonance, Equation of Motion, Line Width, Motional Narrowing, Hyperfine Splitting, Examples: Paramagnetic Point Defects, F Centers in Alkali Halides, Donor Atoms in Silicon, Knight Shift, Nuclear Quadrupole Resonance, Ferromagnetic Resonance, Shape Effects in FMR, Spin Wave Resonance, Antiferromagnetic Resonance, Electron Paramagnetic Resonance, Exchange Narrowing, Zero-Filed Splitting, Principle of Maser Action, Three- Level Maser, Lasers

##### REFERENCE BOOKS :

1. A textbook of quantum mechanics P M Mathews and K V Venkatesan McGrawhill Education
2. Quantum Mechanics by L. I. Schiff, McGraw-Hill International student edition (1961).
3. Introduction to Quantum Mechanics by Powell and Crasemann Addison-Wesley (1961).
4. Quantum Mechanics by V.K. Thankappen, Wiely eastern Ltd.
5. Quantum Mechanics : Theory and applications by A. Ghatak and S. Lokanathan.
6. Quantum Mechanics by H.C.Verma

7. Quantum Mechanics by K.K. Chopra & G.C. Agarwal, Krishna Prakashan Media, (P)LTD. MEERUT
8. Introduction to Solid State Physics. Charles Kittel 7th Edition.
9. Introduction to Solid State Physics. J P Srivastava 4th Edition.
10. Solid State Physics by S.O. Pillai, New age international publishers
11. Fundamental of Solid State Physics by Saxena, Gupta and Kumar Pragati Prakashan



HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN				
PROGRAM CODE	MSPHY	PROGRAM NAME		M.SC.PHYSICS
COURSE CODE	MSPHY 304 CC	SEMESTER		3
<b>ELECTRONICS - 3</b>				
COURSE TYPE	CORE COMPULSORY	TOTAL CREDIT:	04	
TEACHING TIME (HOURS)	<b>EXAMINATION MARKING SCHEME</b>			
THEORY (HRS)	PRACTICAL (MARKS)	INTERNAL (MARKS)	EXTERNAL (MARKS)	TOTAL (MARKS)
4 X 15 = 60	-	30	70 (2.5 HRS)	100

#### UNIT-I

##### PULSE MODULATION AND DIGITAL COMMUNICATION:

###### Pulse Modulation:

Pulse amplitude modulation, Pulse code modulation, PCM Receiver, Pulse time modulation, Pulse position modulation, Pulse width modulation. Synchronization, Probability of bit error in base band transmission, matched filter, Bit-timing recovery, carrier recovery systems.

###### Digital carrier systems:

Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), FSK Transmitter, FSK Receiver, Phase Shift Keying (PSK).

#### UNIT – II

##### DEMODULATION:

Principle of A.M. detection and classification of A.M. detectors, Envelope diode detector, op-amp envelope detector, automatic volume control, frequency demodulation, slope detector, Balanced slope detector, Foster-seeley discriminator, limiter, Radio detector, Quadrature detector, phase locked loop.

#### UNIT – III

##### REMOTE SENSING :

###### Remote Sensing Principles:

Electromagnetic remote sensing process, Radiation laws, Atmospheric interaction with electromagnetic radiation, Interaction with earth surface and spectral signatures,

**Remote Sensing Platforms and Sensor:** Satellite system parameters – instrumental parameters, viewing parameters, Sensor parameters – spatial resolution, spectral resolution, radiometric resolution, Imaging sensor systems.

###### Fundamental of GIS:

GIS Definitions and Terminology, GIS Architecture, Components of a GIS, GIS Work Flow.

#### UNIT – IV

##### POWER ELECTRONICS:

**Fundamental of Power Electronics:** Important rules for finding Fourier Series. Expression for Voltage, Current and Power factor. Laplace Transform, Inverse Laplace Transform. Performance parameter of Rectifiers. Introduction to Discrete Fourier transform.

**Basic of Electrical Machines:** D.C. motors, Types of D.C. motors, torque speed characteristics. Induction motors, Types of Induction motors. Synchronous machines and stepper motors.

**Converters:** Single phase and three phase converters, Series converters, Dual converters. Effect of source and leakage inductance on the performance, Power factor improvement. Single phase dual converter, three phase dual converter, three phase AC voltage controllers

##### REFERENCE BOOKS:

1. Hand Book of Electronics (Basic) Gupta and Kumar, Pragati Prakashan, Meerut
2. Remote sensing and Geographical Information systems, Anji Reddy, B.S. Publications, (3rd edition), 2006

3. Electronic communications, Roddy D. and Coolin J., PHI, 2006
4. Power Electronics P.C. Sen
5. Power Electronics R.M. Jalnekar & N.B. Pasalkar
6. Thyristor power Controllers. C.K Dubey, S.R. Doradla, A. Joshi & R.M. Sinha
7. Power Electronics – By M. Rashid
8. Power Electronics –J. S. Katre Technover Publication
9. Electronic Devices and Components, by J. Seymore (Longmann Scientific & Technical).
10. Integrated Electronics, by K. R. Botkar, (Khanna Publishers.)
11. Integrated Electronics: Analog and Digital Circuits Systems, by J. Millman and C. C. Halkias (Tata McGraw -Hill Publishing Company Ltd.).
12. Solid State Pulse Circuits, by David A. Bell (Prentice Hall of India Pvt. Ltd).
13. Energy Technology (Non conventional, Renewable and conventional), by S. Rao and Dr. P. B.Parrulkar (Khanna Publishers.)

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN				
PROGRAM CODE	MSPHY	PROGRAM NAME		M.SC.PHYSICS
COURSE CODE	MSPHY 301ES	SEMESTER		3
RESEARCH METHODOLOGY				
COURSE TYPE	ELECTIVE SUBJECT	TOTAL CREDIT:	02	
TEACHING TIME (HOURS)	EXAMINATION MARKING SCHEME			
THEORY (HRS)	PRACTICAL (MARKS)	INTERNAL (MARKS)	EXTERNAL (MARKS)	TOTAL (MARKS)
2 X 15 = 30	-	-	50 (2.0 HRS)	50

#### UNIT-I

What is research? Science and research, Basic and applied research, Essential steps in Research.

#### Literature Collection:

Need for review of literature, Review process, Research reading, Reference cards, Literature citation, Different systems.

#### UNIT-II

#### Components of Research Report/Thesis:

Field work and laboratory work, photography, Preparation of tables, Preparation of figures.

#### Research Report/Thesis –Formatting and Typing (Computing):

Title page, certificate, declaration, acknowledgement, list of table, figures, abbreviations and symbols, chapter quotations, table, figures, summary, appendices, references etc.

#### Reference Book:

1. Research Methodology with statistical package for social sciences Dr. A. SafeevanRao&Dr.Dipak, Tyagi, Shree Nivas Pub. -Jaypur
2. Research Methodology G.R Basotia and K.K. Sharma, Mangal Deep Jaypur
3. Research Methodology Modern methods and New techniques M.N. Borse, Shree Nivas Jaipur
4. Research Methodology Modern methods and techniques, Anil Tandon, Annol New Delhi

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN				
PROGRAM CODE	MSPHY	PROGRAM NAME		M.SC.PHYSICS
COURSE CODE	MSPHY 302ES	SEMESTER		3
MICROCONTROLLER				
COURSE TYPE	ELECTIVE SUBJECT	TOTAL CREDIT:	02	
TEACHING TIME (HOURS)	EXAMINATION MARKING SCHEME			
THEORY (HRS)	PRACTICAL (MARKS)	INTERNAL (MARKS)	EXTERNAL (MARKS)	TOTAL (MARKS)
2 X 15 = 30	-	-	50 (2.0 HRS)	50

#### UNIT –I

##### The 8051 Microcontroller

Microprocessor and Microcontroller, The 8051, A Microcontroller Survey, Development System,

**The 8051 Architecture: Introduction:** 8051 Microcontroller hardware, Oscillator and Clock, Program counter and data pointer, A and B Register, Flag and PSW, Internal Memory and RAM, The Stack and Stack Pointer, I/P O/P Pins Ports and circuit, External Memory, TCON Register, Counter and Timers, TMOD Register, Serial Data Input/Output, IE Special Register, IP Special Register

**Ref:** The 8051 Microcontroller Architecture, Programming and Applications, Kenneth J Ayala, West Publication Company.

#### Unit – II

##### The AVR Microcontroller

**AVR architecture and assembly language programming:** The general purpose registers in the AVR, the AVR data memory, Using instructions with the data memory, AVR status register, AVR data format and directives, Introduction to AVR assembly programming, Assembling an program, The program counter and program ROM space in the AVR, RISC architecture in the AVR, Viewing registers and memory with AVR STUDIO IDE.

**Ref:** The AVR microcontroller and embedded system using assembly and C, Muhammad Ali Mazidi, Sarmad Naimi, and Sepehr Naimi, Prentice Hall.



HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN				
Program code :		MSPHY	Program Name : M.Sc PHYSICS	
Course Code		MSPHYPR	Semester : 3	
PRACTICALS(PCT)				
Course type :		Practical	Total credit : 06	
Teaching time (hours)		Examination Marking scheme		
Theory (hrs)	Practical (hrs)	Internal (Marks)	External (Marks)	Total (Marks)
	12 per week		150	150

#### Group – I

1. Young's modulus by optical method
2. G.M. Counter
3. e/m by Helical method
4. Fiber optics
5. Microwave
6. Babinet compensator
7. Fiberless optical communication using IR
8. Microprocessor-Logical operations AND, OR, Demorgan's theorem-Proof
9. C Programming
10. C Programming

#### Group – II

1. Frequency Modulation and Demodulation.
2. Phase shift Oscillator using IC-741.
3. TRIAC characteristics
4. Biastable Multivibrator
5. Study of Integrator.
6. D/A and A/D Convertor.
7. Sawtooth generator using OP-AMP
8. Modulo n-counter.
9. Crystal Oscillator
10. Computer simulation