To,

The Principal Secretary to Governor,

Governor's Secretariat, Bihar, Patna

Reference: Letter No. BSU (UGC)- 02/2023 – 1457/ (GS) (1) dated 14-09-2023

Subject: Preparation of Syllabus for 4 Year Undergraduate Courses in Universities of Bihar for Physics.

Dear Sir,

This is with reference to your letter no. BSU (UGC) 02/2023 – 1457/ (GS) 1 dated 14-09-2023, we are, herewith submitting one set of prepared Syllabus of Bachelor of Science, **Physics** for 4 Year Undergraduate Courses in University of Bihar for Semester III, IV, V, VI VII, VIII.

Following members were authorized by your esteemed office.

With regards,

1.Dr. Awadhesh Prasad Awadhesh Prasad 21.09.2023.
Associate Professor &Head, PG Department of Physics, Veer Kunwar Singh University, Ara
(Mob. No. – 8210531603, Email – draprasadjjc@rediffmail.com)

2.Dr. B.C Rai
21.9.2023
Prof & Head, Department of Physics, C.O.C.A.S, Patliputra University, Patna
(Mob. No. – 9304005275, Email – bcraiphy@gmail.com)

3.Dr. Shankar Kumar Shankar Kumar 21/09/2023
Associate Professor &Head, Department of Physics, Patna Science College, Patna University, Patna, (Mob. No. – 9939811053, Email – drshankarkr@gmail.com)

4.Dr. Aprajita Krishna Aprajita Krishna 21/9/23
Dean Science, Head, Department of Physics, Patna women's College (Autonomous), Patna
(Mob. No. 9431632519, Email – aprajita.phy@patnawomenscollege.in)

5.Prof. B. P. Singh
21/9/23
Professor (Retd.), Department of Physics, T. M. Bhagalpur University, Bhagalpur
(Mob. No. 9430430604, Email- bhrigunandan@gmail.com)

6.Dr. Mahendra Singh M. Singh 21/09/2023
Professor & Head, University Department of Physics,J. P. University, Chapra
(Mob. No. – 9430530994, Email- msdpjpu@gmail.com)

7.Shri Anil Kumar
Professor (Retd.), Department of Physics, J. P. University, Chapra
(Mob. No. – 8210588659, Email- anilnivedita@gmail.com)

8.Prof. M. K. Sharan
Professor (Retd.), University Department of Physics, J. P. University, Chapra
(Mob. 9835426735, Email- mksharan1944@gmail.com)

9.Prof. Achyuta Nand Singh
Professor, University Department of Physics, J. P. University, Chapra
(Mob. No. 8002112563, Email- achyutasingh@gmail.com)

10.Mr. Gopal Prasad Choudhary
Associate Professor, Department of Physics,
R. D. & D. J. College, Munger University, Munger
(Mob. No. – 9431454723, Email- gpc.gopal@gmail.com)

11.Dr.Upendra Kumar
Associate Professor, Department of Physics,G.D. College, Begusarai
(Mob. No. – 9835063005, Email- upendra.physics@yahoo.in)

12.Prof. Dolly Sinha
Pro Vice- Chancellor, Lalit Narayan Mithila University, Darbhanga
Former Pro-VC, Patna University and Professor, Department of Physics, Patna University, Patna
(Mob. No.-9431023670, Email- dspvclnmu@gmail.com)

13.Dr. Nabin Kumar
Professor & Head, University Department of Physics, B. N. Mandal University, Madhepura
(Mob. No. 8002636411, dr.nabinkumar02@gmail.com)

14.Dr. A. B. Gautam
Associate Professor, Department of Physics, S.B.A.N. College, Darheta-Lari, (Arwal), Magadh University, Bodhgaya
(Mob. No. – 9431021405, 9693076529, Email- gautamambuj6@gmail.com)

15.Dr. Ashutosh
Assistant Professor and HEAD, Department of Physics, M. P. Sinha Science College
B.R. Ambedkar Bihar University, Muzaffarpur
(Mob. No. – 7607956575, Email- ashutosh.brabu@gov.in, asingh.rs.ece@iitbhu.ac.in)

16.Dr. Santosh Kumar
Associate Professor, Department of Physics, College of Commerce, Arts, & Science, Patna Patliputra, University, Patna
(Mob. No. – 9470032269, Email-santosh.phy@cocaspatna.ac.in,santoshkumar.coc@gmail.com)

What is B.Sc.?

A B.Sc. (Bachelor of Science) is an undergraduate program for students of science stream. They can pursue this program after completing their 12th grade or Inter in Science (I.Sc.). It is usually a 3 +1 year program.

If you want to make it big in the world of science, this program will lay the foundation for learning and help you explore the various options available in higher education sector, research organizations and industries.

The journey may not always be smooth, but it will be worth the work. It will equip you to become a better human being and also a secure future.

Benefits of a BSc degree in PHYSICS

Name of the Program: B.Sc. Hons in PHYSICS

With a number of subjects available to specialize in, B.Sc. (Hons) in PHYSICS will definitely have a competitive edge. If you have a passion to understand Nature and the Universe then you need to study Physics. Physics will open up a vast world before you and help you understand the behaviour of the biggest bodies like the galaxies, stars, black-holes, planets and satellite to the realm of smallest entities namely nanoparticles, molecules, atoms, nucleus and elementary particles.

There are a number of advantages you may enjoy with the knowledge of Physics. Some of these are:

1. **Personal growth**

Along with increased competitiveness, a B.Sc. degree in Physics also leads to better personal growth including knowledge, analytical ability, reasoning and scientific temper; also equips you with hands on skill to solve or fix instrumental issues in day to day life. A BSc in Physics program helps dealing with the nuances of the workplace too, as you it develops better analytical ability. Thus along with the academic excellence, the youth is better equipped to face challenges in real life as well.

2. Job opportunities in Research and Development fields

A B.Sc. degree can open up a number of job opportunities in the field of science. With a BSc degree, you can opt for the R&D sector, which is the need of the hour.

Expansion of the R&D sector led to the opportunity for internship and more scholarships at industrial and research organization.

The R&D sector has helped students navigate their careers ahead in the field of being a scientist. As the government continues to develop this sector, there are only improvements to be seen on the horizon, with a promising future for BSc Physics students.

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3. Free to expand to other fields

As the economy improves, firms are consistently looking for skilled professionals. Since this field is ever-growing, so does the need to hire such talent. This helps you bag more opportunities and a Physics graduates are higher in demand in the job market.

The high requirement for BSc degrees helps students develop skills that are more in line with what the employers seek.

4. Academic Progression and specialization

The scope for further academic progression and specialization is immense.
A B. Sc. in Physics is eligible to study Master Degree in Physics, Mathematics, Electronics, Computer Science, Data Science, Artificial Intelligence (AI), Library & Information Science, Management, Journalism, B Ed, Law, Cost Accountancy, Chattered Accountancy (CA) and many other programs.

5. Job Profile:

Job profiles for B.Sc. in Physics candidates are quite extensive. A few are mentioned below -

- Science Teacher in Schools
- Lab Instructors
- Scientific Assistant in Science Research organizations namely BARC, ISRO etc.
- Indian Army, Navy and Air Force
- Can appear for State Service Commission Examinations
- Can appear for Union Service Commission Examinations
- Can appear for Indian Forest Service and State Forest Service Examinations
- Banking sector
- Telecom Sector
- Energy Sector particularly Solar Energy and other Green Energies
- Optical & Optometric Industries
- Electrical industries
- Electronics Industries
- Medical, Biomedical and Paramedical Equipment Industries

After obtaining the Master degree in Physics the Job profile further extends to the followings -

- Professor in an Higher academic institutions Researcher
- Scientist
- Research analyst
- Scope to join Foreign Universities

6. Working in close association with renowned Scientists of the world

Good knowledge of Physics will help get jobs in a well-renowned institution/organizations across the world; it helps you work with experts in the field. Hence, networking with peers and world figures can help your personal growth and keep you open to better opportunities.

Close communication with superiors can assist juniors clear their doubts and stay on top of any new advances in the sector.

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High lights of Provisions of 3+1 yrs / 08 Semesters Bachelor Degree Program B A (Honours), B Sc (Honours), B Com (Honours) Curriculum, Syllabus & Examination Regulations Academic Session 2023-27 & onwards Duration of the Program: 4 years

Subject: Regarding implementation of Bachelor of Arts/ Science/ Commerce (Honours) 4-Year Programme under Choice Based Credit System (CBCS) and Semester system as per UGC Regulation (curriculum and Credit Framework for Undergraduate Programme)

Reference:

1. **Governor Secretariat, Bihar Letter No. BSU(UGC)-02/2023-962/GS(I) dated 25.06.2023**
2. **Governor Secretariat, Bihar Letter No. BSU(UGC)-02/2023-687/GS(I) dated 15.05.2023**
3. **Curriculum of 42 Subjects – website of Raj Bhawan (www.governor.bih.nic.in)**

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1. Student of B.Sc.(Hons) program has to select one subject from the basket of subjects which will be named as the Major subject.
   a. Basket of **Major subjects** for B Sc. (Hons) program:
      Physics, Chemistry, Mathematics, Statistics, Botany, Zoology, Geology

2. A student after successfully completing the program will be awarded the Bachelor degree in Science with Honours [B. Sc. (Hons)] in the major subject.
   Example: B. Sc. (Hons) in **Physics,** B. Sc. (Hons) in **Mathematics,** B. Sc. (Hons) in **Botany etc.**

3. **Award/ Certificate, Program Duration, Credit, Exit, Entry options etc. :**
   Bachelor Degree program will be of 4-years duration based on credit based scheme with provisions of **multiple entry and exits** at the beginning and end of each academic year if a student so desire. Details regarding credit are available in serial no. 4.

   ✓ **EXIT Options:**
   यदि छात्र ने अपनी प्रथम/द्वितीय/तृतीय वर्षों की अध्ययन पूरा करने के बाद पढाई रोकना या त्यागना चाहते है तो उस स्थिति में उन्हें स्नातक प्रतिष्टा (B.Sc. Honours) की सर्टिफिकेट/ डिप्लोमा/ डिग्री प्रदान की जायेगी वशर्ते उन्होंने प्रथम/ द्वितीय/ तीन वर्षों के सभी सेमेस्टर्स की सभी कोर्सेस /पत्रों सफलतापूर्वक पूरा कर लिया हो।

   ✓ **Lateral ENTRY OPTION:**
   वे अपनी पढाई अगले तीन वर्षों के अन्दर कभी भी पुनः प्रारम्भ कर सकते है. प्रथम सेमेस्टर (Semester I) से अष्टम सेमेस्टर (Semester VIII) तक की पढाई उन्हें अधिकतम सात वर्षों में पूरी करनी होगी, अन्यथा उनका नामांकन समाप्त हो जायेगा।

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S.No.	Name of the Award	Completion of Semesters & Additional Requisite	Total Credit	Duration
I	**U.G. Certificate**	Sem [I+ II] + One Vocational course (4 Credit) To be done during Summer Vacation	40 +4	One Year
II	**U.G. Diploma**	Sem [I+II+III+IV] + One Vocational course (4 Credit)	80+4	2 Year
III	**3 Year U.G. Degree with Major & Minor**	Successful completion of all 6 semesters Sem [I+II+III+IV +V+VI]	120	3 year
Iva	**Bachelor Hons Degree**	Successful completion of all 8 semesters	160	4 year
IVb	**Bachelor Hons Degree with Research***	Successful completion of all 8 semesters with Research in Major	160	4 Year

*स्नातक प्रतिष्ठा शोध के साथ (B.Sc. Honours with Research) पाठ्यक्रम में प्रवेश केवल उन्हीं छात्रों का हो पायेगा, जिन्होंने पिछले 6 सेमेस्टर में न्यूनतम 7.5 CGPA प्राप्त किया हो।
चौथा वर्ष मुख्य रूप से शोध-आधारित शिक्षा के लिए होगा।

4. क्रेडिट (**CREDIT**):

सम्पूर्ण पाठ्यक्रम क्रेडिट (**CREDIT**) आधारित होगा. क्रेडिट (**CREDIT**) की अवधारणा किसी पत्र (course) का सम्पूर्ण पाठ्यक्रम में महत्त्व (weight-age) को दर्शाता है।

एक क्रेडिट (**01 Credit**) का अर्थ सैधान्तिक पत्र (**Theory Paper**) में न्युनतम 15 घंटा, टुटोरिअल में 30 घंटा तथा प्रायोगिक पत्र में 30 घंटा का वर्ग प्रति सेमेस्टर है।

क्रेडिट-घंटा (**Credit-hour**) सम्बन्ध को नीचे दिये गए टेबल में दर्शाया गया है।

समय-सारणी (टाइम-टेबल) तैयार करते वक्त इसका ध्यान रखना अत्यन्त आवश्यक है।

Credit	Minimum Number of Teaching Learning Hours (T-L-H) per semester for different type of course			
	Theory	Tutorial	Practical	Total
01	15	20	30	
Example of a 6 Credit course with Tutorial (Tu)/ Practical (P):				
06 = 5 (TH)+ 1(Tu)	5X15=75	1X20=20		95
06 = 4(TH)+ 2(P)	4X15=60		2X30=60	120

5. About Courses: A student has to study various types of courses as mentioned below:
छात्र को नीचे बताए अनुसार विभिन्न प्रकार के पाठ्यक्रमों का अध्ययन करना होगा :

i. Major Course (**MJC**)
ii. Minor Course (**MIC**)
iii. Multidisciplinary Course (**MDC**)
iv. Ability Enhancement Course (**AEC**)
v. Skill Enhancement Course (**SEC**)
v. Value Added Course (**VAC**)

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6. **Table I: Number of courses to be studied in different semester :**
(विभिन्न सेमेस्टर में अध्ययन किए जाने वाले पाठ्यक्रमों की विवरणी)

S. No.	Type of Course	Course Code	Number of Courses per Semester with course code								Total Number of course
			SEM I	SEM II	SEM III	SEM IV	SEM V	SEM VI	SEM VII	SEM VIII	
1.	Major Course	MJC	1 MJC-1	1 MJC-2	2 MJC-3 MJC-4	3 MJC-5 MJC-6 MJC-7	2 MJC-8 MJC-9	3 MJC- 10 MJC- 11 MJC- 12	3 MJC-13 MJC-14 MJC-15	1 MJC-16	**16**
2.	Minor Course	MIC	1 MIC-1	1 MIC-2	1 MIC-3	1 MIC-4	2 MIC-5 MIC-6	2 MIC-7 MIC-8	1 MIC-9	1 MIC-10	**10**
3.	Multidisciplinary Course	MDC	1 MDC-1	1 MDC-2	1 MDC-3						**03**
4.	Ability Enhancement Course	AEC	1 AEC-1	1 AEC-2	1 AEC-3	1 AEC-4					**04**
5.	Skill Enhancement Course	SEC	1 SEC-1	1 SEC-2	1 SEC-3						**03**
6.	Value Added Course	VAC	1 VAC-1	1 VAC-2							**02**
Total number of Courses			**06**	**06**	**06**	**05**	04	05	04	02	**38**

Note:
A student will study and attend the Major course (MJC) classes and associated activities in the parent department; other courses namely MIC, MDC, AEC, SEC, VAC to be selected from the respective basket of courses and pursued with the permission of the Head of the Department/ Principal of the College.
Parent department will assist students to choose right combination of courses for MIC, MDC, AEC, SEC, VAC, maintain records **and direct them to right Department/ University Unit for attending classes.**
एक छात्र अपने मूल विभाग में प्रमुख पाठ्यक्रम (एमजेसी) का अध्ययन करेगा और इससे सम्बन्धित अन्य कार्यक्रमों में भाग लेगा; अन्य पाठ्यक्रम अर्थात् एमआईसी, एमडीसी, एईसी, एसईसी, वीएसी पाठ्यक्रमों को संबंधित श्रेणी से चुनेगा और विभागाध्यक्ष की अनुमति से अध्ययन करेगा। मूल विभाग छात्रों को पाठ्यक्रमों का सही संयोजन चुनने में सहायता करेगा। मूल विभाग अपने विषय में स्नातक करने वाले सभी छात्रों द्वारा चुने गए सभी पाठ्यक्रमों का रिकॉर्ड रखेगा। मूल विभाग छात्रों को एमआईसी, एमडीसी, एईसी, एसईसी, वीएसी के लिए संबंधित विभागों द्वारा आयोजित कक्षाओं में एवं अन्य कार्यक्रमों में भाग लेना के लिया प्रोत्साहित करेगा ।
A student may opt from course available on SWYAM/MOOC for SEC and MDC with the permission of the parent Department/ College administration.
एक छात्र मूल विभाग/कॉलेज प्रशासन की अनुमति से SEC और MDC के लिए SWYAM/MOOC पर उपलब्ध पाठ्यक्रम का विकल्प चुन सकता है।

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7. **Examination & Evaluation of Performance Under Semester System**

सेमेस्टर प्रणाली के तहत परीक्षायें और मूल्यांकन :

The performance of a student in each paper will be assessed on the basis of a **Continuous Internal Assessment (CIA)** of **30 marks** and the **End of Semester Examination (ESE)** consisting of **70 marks.**

प्रत्येक पेपर में एक छात्र के प्रदर्शन का मूल्यांकन 30 अंकों के सतत आंतरिक मूल्यांकन (सीआईए) और 70 अंकों की सेमेस्टर परीक्षा (ईएसई) के आधार पर किया जाएगा।

a. The **components of C.I.A.** will be as mentioned below (सी.आई.ए. के घटक नीचे बताए अनुसार होगा) :

(i)	One written tests of 90 minutes duration each; 1X15	= 15 Marks
(ii)	Seminar/Quiz/ Presentation	= 05 Marks
(iii)	Assignment	= 05 Marks
(iv)	Attendance and conduct	= 05 Marks
	Total	= 30 Marks

The CIA component shall be conducted and evaluated by the concerned course-teacher.

सीआईए घटक का संचालन और मूल्यांकन संबंधित पाठ्यक्रम-शिक्षक द्वारा किया जाएगा।

b. The **End Semester Examination (ESE)** :

End semester Examination (ESE) will be written test of 3- hour duration and be conducted by the University.

अंतिम सेमेस्टर परीक्षा (ईएसई):

अंतिम सेमेस्टर परीक्षा (ईएसई) 3 घंटे की अवधि की लिखित परीक्षा होगी और विश्वविद्यालय

द्वारा आयोजित की जाएगी।

c. The **Question Paper Pattern of Theory papers in ESE:**

Part A:	10 Compulsory Multiple Choice Questions (MCQ):	2X10 =20 marks
Part B:	06 Short Answer Type Questions- 04 to be answered	5X04 =20 marks
Part C:	05 Long answered type questions- 03 to be answered	10X3 =30 marks
	Total	= 70 Marks

d. The evaluation of laboratory paper and field work, wherever applicable will also be based on CIA and an end-semester practical examination. प्रयोगशाला पेपर और फील्ड कार्य का मूल्यांकन, जहां भी लागू हो, सीआईए और अंतिम सेमेस्टर की व्यावहारिक परीक्षा पर आधारित होगा।

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e. All such examination shall be as per the provisions of examination board and moderation board of the ~~L N Mithila~~ respective University. ऐसी सभी परीक्षाएं ~~एलएन~~ ~~मिथिला~~ विश्वविद्यालय के परीक्षा बोर्ड और मॉडरेशन बोर्ड के प्रावधानों के अनुसार होंगी।

f. **Only those students who have 75% attendance and secured minimum qualifying marks in of 45% in the CIA shall be allowed to fill up the End Semester Examination form.**
केवल उन्हीं छात्रों को अंतिम सेमेस्टर परीक्षा फॉर्म भरने की अनुमति दी जाएगी जिनकी उपस्थिति 75% है और सीआईए में 45% में न्यूनतम योग्यता अंक प्राप्त किए हैं।

g. **The marks of CIA in each paper be submitted on line by the Department/ College to the L N M U Examination portal before the examination form filing date, failing which the student may not be issued examination admit card.**
प्रत्येक पेपर में सीआईए के अंक परीक्षा फॉर्म भरने की तारीख से पहले विभाग/कॉलेज द्वारा एल एन एम यू परीक्षा पोर्टल पर ऑनलाइन जमा किए जाने चाहिए, ऐसा न करने पर छात्र को परीक्षा प्रवेश पत्र जारी नहीं किया जा सकता है।

h. It is mandatory for a student to pass in the both CIA and ESE. The pass marks for CIA as well as ESE is 45%.
छात्र को आतंरिक (CIA) एवं विश्वविद्यालय स्तरीय परीक्षा (ESE) में अलग-अलग उतीर्ण होना आवश्यक होगा। किसी पत्र में उतीर्ण होने के लिए परीक्षार्थि को न्यूनतम 45 प्रतिशत अंक प्राप्त करना आवश्यक होगा।

i. A student who fails in any course and promoted to the next semester has to clear backlog course/s in the subsequent ESE or whenever University conducts the examination of such course/s.
एक छात्र जो किसी भी पाठ्यक्रम में असफल हो जाता है और अगले सेमेस्टर में पदोन्नत हो जाता है, उसे बाद के ईएसई में या जब भी विश्वविद्यालय ऐसे पाठ्यक्रम की परीक्षा आयोजित करता है, बैकलॉग पाठ्यक्रम को पास करना होगा।

j. A student shall be awarded Semester Grade Point (SGPA) at the End of each Semester till Semester V.
एक छात्र को सेमेस्टर V तक प्रत्येक सेमेस्टर के अंत में सेमेस्टर ग्रेड प्वाइंट (एसजीपीए) प्रदान किया जाएगा।

k. Finally after successfully completing the Semester VI, the result will be awarded based on Cumulative Grade Point (CGPA).
अंततः सेमेस्टर VI को सफलतापूर्वक पूरा करने के बाद परिणाम, संचयी ग्रेड प्वाइंट (सीजीपीए) के आधार पर प्रदान किया जाएगा।

l. Students who will study Semester VII & VIII will get final result and degree after the VIIIth semester.

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Bachelor of Science Honours Degree B.Sc. (Hons)
Program Outcome (PO)

After the completion of the program, student will attain the ability to the followings:

PO1: Acquire a systematic and coherent understanding of a number of courses of academic core subject, minor subject along with multidisciplinary subjects, skill enhancement in chosen area and training on various vocational courses.
PO2: Enable the graduate to peruse academic progression in different fields including Master degree in the Major subject, B. Ed. MBA, Master in Information & Library Science, Master in Journalism etc.
PO3: A B.Sc. degree leads to better personal growth including knowledge, analytical ability, reasoning and scientific temper
PO4: Equips with hands on skill to solve or fix instrumental issues in day to day life
PO5: Employ scientific knowledge to pursue Research
PO6: Improves employability index
PO7: Eligible for State Public Services Competitive Examinations, Union Public Services Competitive Examinations, Indian Forest Services, Banking Sector, Insurance Sector
PO8: Teaching in schools
PO9: Self Employment - teaching School students, NGO, Start Ups,
Using the training in SEC & VAC enable livelihood generation

B. Sc. Honours in Physics
Program Specific Outcome {PSO}

PSO1: Develop strong competencies in Physics and its applications in technology rich interactive environment.
PSO2: Enable further academic progression to Master degree in a number of streams
PSO3: Enable to join Research directly and work in theoretical as well as experimental problems
PSO4: Enable to study and work in the area of Computer Science, Data science, Artificial Intelligence (AI), Machine Learning etc.
PSO5: Applying conceptual knowledge of Physics to real world situations
PSO6: Improves general employability index compared to other subjects
PSO7: Evolve as a better Human being with logical reasoning, scientific temperament and analytical ability
PSO8: Acquire Global Competencies

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SEMESTER- III

MJCPHY03: Thermal Physics &Thermodynamics

Course Title	Credit	Credit Distribution	
		Theory	Practical
Thermal Physics &Thermodynamics	5	3	2

Course Outcomes

After the completion of the course, the student will be able to:

CO1: Comprehended the basic concepts of thermodynamics, the first and the second law of thermodynamics.

CO2: Understand the concept of entropy and the associated theorems, the thermodynamic potentials and their physical interpretations.

CO3: Learn about Maxwell's relations and use them for solving many problems in Thermodynamics.

CO4: Learn the basic aspects of kinetic theory of gases, Maxwell-Boltzmann distribution law, equipartition of energy, mean free path of molecular collisions transport phenomenon like: viscosity, thermal conductivity, diffusion and Brownian motion.

CO5: Get background for further studies and research in different subject areas namely condensed matter physics, chemistry , material science and life sciences.

MJCPHY03: Thermal Physics &Thermodynamics (T)- 03 Credit		
Unit	**Topics to be covered**	**No. of Lectures**
1	**Kinetic Theory of Gases** Maxwell-Boltzmann Molecular Speed distribution Law for an Ideal Gas. Mean, RMS and Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy (no derivation). Molecular Collisions: Mean Free Path. Estimation of Mean Free Path. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian motion, Langevin and Einstein's theories and experimental determination of Avogadro's no., Rectilinear flow of heat in a metal rod, Relation between thermal & electrical conductivities.	15
2	**Real Gases** Behavior of Real Gases. Van der Waal's Equation of State for Real Gases. Values of Critical Constants. Law of Corresponding States. Joule-Thomson Porous Plug Experiment. Joule-Thomson Effect for Real Gases. Joule-Thomson Cooling.	09

3	**Zeroth and First Law of Thermodynamics** Extensive and intensive Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics and Concept of Temperature, Work, Heat, State Functions and path functions, First Law of Thermodynamics, Internal Energy for ideal and real gases, Applications of First Law of thermodynamics in case of thin film, stretched wire, hydrostatics, and specific Molar Heat Capacity for gases, Relation between C_P and C_V.	09
4	**Second Law of Thermodynamics** Cyclic ,reversible and irreversible process, Carnot engine, Carnot cycle, Second Law of thermodynamics. Principle of heat engine and refrigerator Kelvin-Planck and Clausius Statements. Concept of Entropy, Clausius Inequality, Second Law in terms of Entropy, Temperature–Entropy diagrams. Third Law of thermodynamics, Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz & Gibb's Functions, Maxwell's Relations, Co-efficient of performance, Clausius-Clapeyron equation and phase transition (1^{st} and 2^{nd} order)	15
	TOTAL	**48**

MJCPHY03: Thermal Physics &Thermodynamics (P)- 02 Credit	
1.	To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2.	To determine the Coefficient of Thermal Conductivity of good conductor (Cu) by Searle's Apparatus.
3.	To determine the Coefficient of Thermal Conductivity of good conductor (Cu) by Angstrom's Method.
4.	To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlto's disc method.
5.	To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).
6.	To study the variation of Thermo-emf of a Thermocouple with difference of Temperature of its two Junctions using a null method.
7.	To determine Mechanical Equivalent of Heat (J) with the help of Joule's calorimeter.
8.	To plot a graph between temperature and pressure at constant volume using Joly's apparatus and to find the coefficient of increase of pressure at constant volume.
9.	To study the adiabatic expansion of a gas and hence to find the value of the ratio of specific heat at constant pressure to specific heat at constant volume for air using Clement and Desorme's apparatus.

Suggested Readings :

1. Thermal Physics - S. Garg, R. Bansal and C. Gosh (Tata McGraw-Hill.)
2. Heat and Thermodynamics - M.W. Zemansky, Richard Dittman (McGraw-Hill.)
3. A Treatise on Heat – Meghnad Saha, and B.N. Srivastava (Indian Press)
4. Classical and Quantum Thermal Physics - R. Prasad (Cambridge University Press)
5. Modern Thermodynamics with Statistical Mechanics - Carl S. Helrich (Springer)
6. Thermodynamics, Kinetic Theory & Statistical Thermodynamics - Sears & Salinger (Narosa)
7. Concepts in Thermal Physics - S.J. Blundell and K.M. Blundell (University Press)

SEMESTER- III

MJCPHY- 04: Electricity & Magnetism

Course Title	Credit	Credit Distribution	
		Theory	Practical
Electricity and Magnetism	4	3	1

Course Outcomes

After the completion of the course, the student will be able to:

CO1: Understand the basic concepts of electrostatics.

CO2: Understand the dielectric and magnetic properties of matter.

CO3: Understand the electromagnetic induction and electric circuits.

CO4: Provides background for further studies and research in different subject areas .

MJCPHY03: Thermal Physics &Thermodynamics (T) - 03 Credit

Unit	Topics to be covered	No. of Lectures
1	**Electrostatics:**Electric Field and potential, Field due to a uniformly charged sphere, Gauss Law and its applications: The Field of a conductor. Electric dipole, Field and potential due to an electric dipole, Dipole approximation for an arbitrary charged distribution, Electric quadruple, Field due to a quadrupole, Electrostatic Energy of a uniformly charged sphere, Poisson and Laplace Equations, applications of Laplace equation.	10
2	**Dielectric Properties of Matter:**Electric field in matter and Electrical susceptibility and Dielectric polarization, Dielectric constant, Polarisation vector, Surface Charge and bound charge, Displacement Vector **D**, Relations between **E**, **P** and **D**.	08
3	**Magnetism:**Magnetic field , Magnetic force and Torque on a current carrying conductor, and loop placed in a magnetic field, Biot – Savart's Law and its simple applications: straight wire and circular loop, Magnetic Dipole, Magnetomotive force and Ampere's Circuital theorem and its applications to calculate magnetic field due to current carrying wire and solenoid and toroid. Gauss's law of magnetism (Integral and Differential Forms). Relative Permeability of a Material. Magnetic Susceptibility. Magnetization Vector (I),or intensity of magnetisation. Magnetic Intensity (H). Relation between B, I and H. Magnetic Energy stored in Matter. Magnetic Circuit. Potential Energy of a Current Loop placed in a magnetic field.Ballistic Galvanometer:. Electromagnetic Damping, Logarithmic Damping, Critical Damping Resistance(CDR)	12

4	**Electromagnetic Induction:** Faraday's and Lenz's Laws. Mutual and Self Induction,self and Mutual inductances of a solenoid and system of current carrying loop, Energy stored in a Magnetic Field, Electric field induced due to time varying Magnetic field, magnetic field induced due to Time varying electric field. Introduction to Maxwell's Equations	05
5	**Electrical Circuits:** AC Circuits: Kirchhoff's laws for AC circuits. Reactance and Complex Impedance. Series and parallel LCR Circuit: Resonance, Quality Factor, and Band Width, Power in AC Circuits	10
	Total	**45**

MJCPHY- 04: Electricity & Magnetism (P) - 02 Credit

1. Use of Multimeter for measuring (a) Resistance, (b) AC and DC Voltages, (c) DC Current, (d) Capacitance, and (e) Checking electrical fuses.
2. To calibrate the ammeter and voltmeter by potentiometer.
3. To find the low resistance by Carey Foster's bridge after calibrating the bridge wire.
4. Measurement of low resistance using Potentiometer.
5. To determine the high resistance by leakage method.
6. Figure of merit of moving coil galvanometer.
7. To determine the angle of dip in the laboratory using an earth inductor.
8. Compare the capacities of capacitors by De Sauty' bridge.
9. To study the characteristics of a series RC Circuit.
10. To verify the Thevenin and Norton theorems.
11. To verify the Superposition, and Maximum power transfer theorems.
12. To determine self inductance of a coil by Anderson□s bridge.
13. To study the response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.
14. To study the response curve of a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q.

Suggested Books :

1. Electricity and Magnetism, Basudev Ghosh (Books And Allied (P) Ltd
2. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn (Benjamin Cummings)
3. Electricity ad Magnetism
4. Fundamentals of Electricity and Magnetism, Arthur F. Kip (McGraw-Hill)
5. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury (Tata McGraw-Hill)
6. Fundamentals of Electricity and Magnetism D.N Vasudev (S. Chand & Co)
7. Electricity and Magnetism- R. Murugeshan (S. Chand)
8. Electricity and Magnetism-K.K. Tiwary (S. Chand)
9. Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, (Asia Publishing House)
10. A Text Book of Practical Physics, I. Prakash & Ramakrishna, (Kitab Mahal)
11. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, (Heinemann Educational Publishers)
12. Engineering Practical Physics, S. Panigrahi and B.Mallick, Cengage Learning.
13. B. Sc. Practical Physics, C. L. Arora, S. Chand and Co.

SEMESTER – IV

MJCPHY05: Mathematical Physics-II and Introduction to Computational Methods

Course Title	Credit	Credit Distribution	
		Theory	Practical
Mathematical Physics-II and Introduction to Computational Methods	5	3	2

Course Outcomes

After the completion of the course, the student will be able to:

CO1: Master the basic elements of complex mathematical analysis.
CO2: Solve differential equations that are common in physical sciences.
CO3: Apply group theory and integral transforms to solve mathematical problems of interest in Physics.
CO4: Understanding how to use special functions in various physics problems
CO5: Provides background for further studies and research in different subject areas .

MJCPHY05	Mathematical Physics and Introduction to Computational Methods (T) -03 Credit	
Unit	**Topics to be covered**	**No. of Lectures**
1	**Curvilinear Coordinates, Tensors and special functions:** Spherical and Cylindrical Coordinate Systems. Ordinary Integrals of Vectors, Line, surface and volume integrals of Vector fields. Tensors : Elementary properties, Contra variant and covariant tensors, Symmetric and Anti-symmetric tensors. Singular Points of Second Order Linear Differential Equations and their importance , Frobenius method and its applications to differential equations Legendre, Bessel, Hermite and Laguerre Differential Equations.	09
2	**Partial Differential Equations and Complex Analysis :** Solutions to partial differential equations using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry. Complex Numbers Graphical Representation Euler's formula, De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions Cauchy's Inequality. Cauchy's Integral formula. Simply and multiply connected region. Integration of function of a complex variable.	10
3	Introduction : Importance of Computers in Physics , Algorithms and Flow Charts : Algorithm Definition, properties and development. Flowchart: concept of flowchart , symbols , guidelines, types. Sum of two matrices, sum & Products of a finite series , calculations of Sin (x) as a series.	06
4	Scientific Programming : Usage of Linux an Editor, some fundamental Linux commands (Internal & External commands) Development of FORTRAN, Basic elements of FORTRAN : Character set, constants and their types, variables and their types , Keywords , variable Decleration and concept of instruction and program. Operators : Arithmatic, Relational , Logical and Assignment operators. Expressions : Arithmatic Relational, Logical , Character and Assignment Expressions. FORTRAN Statements: I/O statements	06

	(unformatted/formatted), Executable and Non-Executable statements, Layout of FORTRAN program, Format of writing program and concept of coding.	
5	Control statements : Types of Logic (sequential, selection, Repetition), Branching statements (Logical IF, Arithmatic IF, Block IF , Nested Block IF, SELEC CASE and ELSE IF Ladder Statements), Looping statements (DO-CONTINUE, DO-ENDDO, DO-WHILE, Implied and Nested DO Loops), Jumping statements (Unconditional GO TO , computed GO TO, Assigned GO TO), Subscripted variables, Functions and Subroutines (Arithmetic statements, Function, Function subprogram and subroutine), Examples from physics Problems.	09
	Total	**40**

MJCPHY05	**Mathematical Physics and Introduction to Computational Methods (P) -02 Credit**
1.	Errors & error Analysis: Truncation & rounding of errors, absolute & relative errors.
2.	Differential equations: Solutions of ordinary differential equation, solution of first order differential equation, solution of quadratic equation.
3.	Computer Architecture and Organization, Memory and Input/Output devices.
4.	Basics of Scientific computing : Binary and decimal arithmetic, Floating point numbers, Algorithms, Single & Double precision arithmetic, underflow & overflow.
5.	**Programs :** Sum & average of a list of numbers, Largest of a given list of numbers and its location in the list, Sorting of numbers in ascending descending order, Familiarity with DOS commands, Linux Commands and FORTRAN commands.

Suggested Readings :

1. An Introduction to Computational Physics : T. Pang (Cambridge University Press)
2. Elementary Numerical Analysis : K.E Atkinson (Wiley India Edition)
3. Numerical Recipes in C : The Art of Scientific Computing, W.H. Pressetal (Cambridge University)
4. Introduction to Numerical Analysis : S. S Sastry
5. Mathematical Methods for Physicists : Arfken, Weber (Pub. Elsevier)
6. Mathematics for Physicists : Susan M. Lea (Pub. Thomson Books)

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Semester IV

MJCPHY06: Electrodynamics and Electromagnetism

Course Title	Credit	Credit Distribution	
		Theory	Practical
Electrodynamics and Electromagnetism	5	5	0

Course Outcomes

After completing the course, the students will be able to:

CO1: Establish and analyse four Maxwell's equations of electromagnetism.

CO2: Uunderstand the propagation of electromagnetic waves in vacuum, dielectrics, conductors and also in guided media and the phenomenon of reflection and refraction of plane waves at different boundaries.

CO3: Understand the importance of energy flow (Poynting Theorem) and its usefulness.

CO4: Get background for further studies and research in different subject areas.

MJCPHY06	**Electrodynamics and Electromagnetism (T) - 05 Credit**	
Unit	**Topics to be covered**	**No. of Lectures**
1	**Maxwell's Equations:**Equation of continuity, Displacement Current Maxwell's equations in differential and Integral forms; Vector and scalar potentials, Poynting theorem and Poynting vector, energy conservation (qualitative idea of momentum conservation). Electromagnetic (EM) Energy Density. Physical Concept of Electromagnetic Field Energy Density, Momentum Density, Description of Lorentz force.	10
2	**Electromagnetic Wave Propagation in unbounded media:** Propagation of plane EM waves in free space and dielectrics ,Transverse nature of plane EM waves, refractive index and dielectric constant, wave impedance. Propagation of EM wave through conducting media, relaxation time, skin depth.	14
3	**EM Wave Propagation in Bounded Media:** Boundary conditions at a plane interface between two media. Reflection and Refraction of plane waves at plane interface between two dielectric media — Laws of Reflection and Refraction. Fresnel's Formulae for perpendicular & parallel polarization cases, Brewster's law. Reflection & Transmission coefficients. Total internal reflection. Metallic reflection (normal Incidence).	14
4	**Polarization of Electromagnetic Waves:** Description of Linear, Circular and Elliptical Polarization. Uniaxial and Biaxial Crystals. Light Propagation in Uniaxial Crystal. Double Refraction. Polarization by Double Refraction.	10

5	**Transmission Line:** Propagation of e.m. wave through transmission line, reflection coefficient, standing wave, characteristic impedance, propagation constant. **Wave Guides:** Fundamentals of wave guides, Condition of continuity at the interface. Expressions for field components, TE and TM modes. Propagation properties, cutoff frequency,. Field energy and Power transmission. **Optical Fibres:** Numerical Aperture. Step and Graded Indices (Definitions Only). Single and Multiple Mode Fibres (Concept and Definition Only).	12
	Total	**60**

Suggested Books:

1. Introduction to Electrodynamics, D.J. Griffiths, Benjamin Cummings. ,
2. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner,Springer
3. Electromagnetic Fields & Waves, P. Lorrain & D. Corson, W.H. Freeman& Co.
4. Electromagnetics, J. A. Edminster, Schaum Series, Tata McGraw Hill.
5. Electromagnetic field theory fundamentals, B. Guru and H. Hiziroglu, Cambridge University Press.
6. Electrodynamics and Plasma Physics S.L.Kakan ,C. Herajan, CBS publisher
7. Electrodynamics :K.K Chopra &G.C Aggrawal
8. Classical Electrodynamics J D Jakson Wiley

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Semester IV

MJCPHY07: **Optics**

Course Title	Credit	Credit Distribution	
		Theory	Practical
Optics	5	3	2

Course Outcomes

After the completion of the course, the student will be able to:

CO1: Understand Interference as superposition of waves from coherent sources derived from same parent source.
CO2: Demonstrate basic concepts of Diffraction: Superposition of wavelets diffracted from aperture.
CO3: Understand Fraunhoffer and Fresnel Diffraction.
CO4: Gain experience of using various optical instruments and making finer measurements of wavelength of light using Newton's Rings experiment, Fresnel Biprism, etc.
CO5: Get background for further studies and research in different subject areas.

MJCPHY 7	Optics (T) - 3 credit	
Unit	**Topics to be covered**	**No. of Lectures**
1	**Interference:** Light as EM Wave(Historical Perspective),Superposition of waves, Conditions for interference, Interference by Division of Wavefront (Fresnel's Biprism, Lloyd's single mirror) and by Division of Amplitude (Interference by Film), Newton's Ring, Complex Representation for Intensity calculation, Stoke's treatment.	12
2	**Interferometer:** Michelson interferometer and its applications, Multiple beam interference in parallel film, Fabry-Perot interferometer, Coherence – Spatial and Temporal.	08
3	**Fraunhofer Diffraction:** Conditions for diffraction, Fraunhofer diffraction due to single, double and multiple slits, Plane transmission grating. **Fresnel diffraction:** Fresnel half- period zones, Zone plate, Huygen's-Fresnel principle, Diffraction by a circular aperture, Diffraction by a straight edge,Rayleigh's criterion for limit of resolution, Resolving power of Grating, Telescope and Microscope.	12
4	**Polarization and Double Refraction:** Polarized light and its mathematical representation, Production of polarized light by reflection, refraction and scattering, Polarization by double refraction, Nicol prism, Quarter wave plate, Half wave plate, Babinet's compensator, Production and analysis of circularly and elliptically polarized light, Optical activity and Fresnel's theory, Bi-quartz polarimeter. Elementary ideas of LASERs,Einstein's A & B coefficients, Population Inversion and Holography.	13
	TOTAL	**45**

MJCPHY 7	Optics (P) - 02 Credit
1.	To determine Magnifying Power of a telescope by the Slit method/ Linear Scale using Microscope.
2.	To find the height of an inaccessible object (altitude or angular diameter of the Sun) using Sextant.
3.	To find angle of prism/ angle of minimum deviation and hence refractive index of material of prism using Spectrometer.
4.	To find value of Cauchy's Constant A and B for the material of a given prism using a Mercury Vapour Lamp.
5.	To determine Resolving Power of a prism.
6.	To determine diameter of a thin wire by studying the diffraction (and interference) pattern.
7.	To determine wavelength of sodium light using a plane diffraction grating.
8.	To determine Resolving Power of a plane transmission grating.
9.	To establish the dispersion relation for a plane transmission grating.
10.	To verify Fresnel's Law of reflection and refraction by using a plane refracting surface.
11.	Simple experiment demonstrating different applications of LASER and Optical Fibre.
12.	Determination of wavelength of light using biprism on optical bench.
13.	To determine the wavelength of the monochromatic light by Newton's Ring
14.	To determine the specific rotation of the cane sugar solution using bi-quartz polarimeter.

Suggested Readings :

1. Practical Physics : Geeta Sanon (S.Chand & Company); Harnam Singh & P.S. Hemne (R.Chand & Co.)
2. A Text Book of Practical Physics: Indu Prakash, Ramakrishna&A.K.Jha, Kitab Mahal
3. Advanced level Physics Practicals: Michael Nelson and Jon M. Ogborn, Heinemann Educational Publishers
4. A Laboratory Manual of Physics for undergraduate classes: D.P.Khandelwal, Vani Pub.
5. Practical Physics: G.L. Squires, Cambridge University Press.
6. A Laboratory Manual of Physics – D.P.Khandewal.
7. Optics- Eugene Hecht (Pearson).
8. Optics(Classical & Quantum)-Dr. R.K.Kar(Books & Allied).
9. Optics: Ajoy Ghatak, McGraw-Hill Education, New Delhi
10. Fundamental of Optics: Jenkins & White (Mc Graw Hill)
11. Fundamental of optics: B. K. Mathur,
12. Optics: Francis Weston Sears Addison-Wesley Publishing Company

SEMESTER – V

MJCPHY08: Elements of Modern Physics

Course Title	Credit	Credit Distribution	
		Theory	Practical
Elements of Modern Physics	5	5	0

Course Outcomes

After the completion of the course, the student will be able :

CO1: To understand the inadequacy of classical Mechanics.

CO2: To understand the historical development of Quantum Concepts.

CO3: To understand the behaviour of mother nature at microscopic level.

CO4: To prepare background for interdisciplinary research in condensed matter / Material Science/atomic Physics/Life Science etc.

CO5: To enhance employability skills as scientific officers at different research orientated centres

CO6: To promote application of nuclear energy in various areas

CO7: To Get background for further studies and research in different subject areas.

MJCPHY08	Elements of Modern Physics (T) - 6 Credit	
Unit	**Topics to be covered**	**No. of Lectures**
1	**Particle Properties of Radiations** Black Body Radiation and Planck's quantum Hypothesis, Discovery and Explanation of Photoelectric effect, Compton Scattering, Pair Production and Annihilation. **Wave Aspect of Particles** Idea De Broglie wavelength and matter waves, Davisson-Germer experiment for diffraction of electron, G.P. Thomson Experiment ,Phase velocity, wave packets and Concept of Velocity .	10
2	**Wave-Particle Duality** Concept of Wave-particle duality, Heisenberg Uncertainty Principle, Uncertainty relations involving canonical pair of variables and their Derivation from Wave Packets, Estimation of minimum energy for a confined particle using uncertainty principle, origin of natural width of emission lines, Uncertainty Principle and concept of Bohr Orbit.	10

3	**Atomic Structure** Introduction of Sommerfeld Quantization rule, Bohr -Sommerfield atomic theory ,Explanation of Hydrogen and Hydrogen-like Spectra, Comparison between H and He+ Spectra, Corrections for finite nuclear mass and corresponding variations in Rydberg Constant, Relativistic correction .	10
4	**Wave Mechanical Description of electron particles,** The Schrodinger Wave equation, properties ,concept of normalization of Wave function , Expectation value, Schrodinger equation for non-relativistic particles, Concept of operators in quantum mechanics. Time independent Schrodinger equation, Probability, probability current densities, Idea of energy eigenvalues and eigenfunctions	10
5	**Fundamental Properties of Nucleus** Size, constituent and structure of atomic nuclei, Idea of Isotope, Isobar, Isotope and Mirror nuclei , Mass defect, Packing fraction, Binding energy, Binding Energy per nucleon versus Mass number Curve. Stability of the nucleus and Nature of Nuclear force , Law of radioactive decay, Mean life and Half-life, successive radioactive disintegration, Basic Idea of Alpha , Beta and Gamma decay, Idea of energy-momentum and parity conservation in nuclear decay process, Q-value in nuclear reaction. Radiation Detector, Ionization Chamber, Geiger-Muller Counter, Neutron detection, Spark chamber, Bubble, Cloud and Scintillation, Cherenkov radiation.	20
	TOTAL	**60**

Suggested Readings :

1. Concepts of Modern Physics, Arthur Beiser, McGraw-Hill.
2. Introduction to Modern Physics – H.S. Mani & G.K Mehta (PHI)
3. Elements of Nuclear Physics - M L Prasad, RPS (Kedarnath Ramnath)
4. Q. Mechanics – H.C Verma (Surya Pub.)
5. Atomic & Nuclear Physics - K. Gopala Krishnan (Mac Million India Ltd.)
6. Modern Physics - S.K Gupt & B.S. Agarwal (Kedarnath Ramnath)
7. Introduction to Modern Physics – F.K Richtmyer, E.H Kennad , T. Lauritsen (Mac Grow)

SEMESTER – V

MJCPHY09: Basic Electronics

Course Title	Credit	Credit Distribution	
		Theory	Practical
Basic Electronics	5	3	2

Course Outcomes

After the completion of the course, the student will be able to:

CO1: Understand fundamental designing concepts of different types of Logic Gates, Minimization techniques etc.

CO2: Design of different types of the Digital circuits, and to give the computational details for Digital Circuits.

CO3: Draw characteristics of devices like PNP and NPN junction diode and truth tables of different logic gates.

CO4: Understand basic elements and measurement of their values with multimeter and their characteristic study.

CO5: Get background for further studies and research in different subject areas.

MJCPHY 9	Basic Electronics (T) - 3 Credit	
Unit	**Topics to be covered**	**No. of Lectures**
1	**Digital Circuits:** Diffrence between Analog & Digital Circuits .BinaryNumbers.Decimal to Binary & vice-versa. AND,OR and NOT Gates(Realisation using Diodes & Transistors) NAND and NOR Gates as Universal gates.XOR and XNOR Gates.	04
2	**Basic Circuit Operations:** De Morgan's Theorem .Boolean Laws .Simplification of Logic Circuit using Boolean Algebra.Fundamental Products. Minterms and Maxterms. Conversion of a Truth Table into an Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map (For Advanced Learners) **Combinational circuits:** Basic idea of Binary Addition. Binary Subtraction using 2's Complement. Half and Full Adders. Half & Full Subtractors.	08
3	**Semiconductor Devices :** P-andN-type semiconductors. Energy Level Diagram. Barrier Formation in PN Junction Diode. Qualitative Idea of Current Flow Mechanism in Forward and Reverse Biased Diode.P-N junction & its characteristics.Static and Dynamic Resistance.Principle and structure of (1) LEDs (2) Photodiode (3) Zener Diode (4) Solar .Cell. **Electronic Devices and their Applications:** (1) Rectifier Diode: Half-wave Rectifiers. Full-wave Rectifiers (Centre-tapped and Bridge), Calculation of Ripple Factor and Rectification Efficiency. (2) Voltage	14

	Regulation using Zener Diode. **Bipolar Junction transistors**:n-p-n and p-n-p Transistors, Characteristics of CB, CE and CC Configurations. Current gains α and β parameters, Relations between α and β parameters. Load Line analysis of Transistors. DC Load line and Q-point. Physical Mechanism of Current Flow: Active, Cutoff and Saturation Regions. **Amplifiers:** Transistor Biasing circuits and Stability. Fixed Bias and Voltage Divider Bias circuit for CE Amplifier. (h-parameter Equivalent Circuit). Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains. Class A, B & C Amplifiers (For Advanced Learners).	
4	**Operational Amplifiers (Black Box approach):** Characteristics of an Ideal and Practical Op-Amp (IC 741), Open – loop Gain . CMRR, Concept of virtual ground. Applications of Op-Amp:(1) Inverting and Non-Inverting Amplifiers (2) Adder (3) Subtractor (4) Differentiator (5) Integrator . Feedback and Oscillation: Effects of Positive and Negative Feedback on Gain and Stability, Distortion and Noise. Sinusoidal Oscillators: Barkhausen's Criterion for self-sustained oscillations. RC andWien Bridge oscillator.	08
5	**Instrumentations:** Introduction to CRO:Block Diagram and Applications of CRO: (1) Study of Waveform (2) Measurement of Voltage ,Current ,Frequency and Phase Difference. **Power Supply:** Half Wave Rectifiers ,Centre-tapped and Full wave Rectifiers ,Calculation of Ripple Factor and Rectification Efficiency ,Basic Idea about capacitor filter , Zener Doide and Voltage Regulation. **Timer IC:** IC 555 Pin diagram and its applications as Astable and Monostable Multivibrators.	11
	TOTAL	**45**

MJCPHY09	**Basic Electronics (P) - 2 Credit**
1.	To measure (a) Voltageand (b) Time period of a periodic waveform using CRO.
2.	To test a Diode and Transistor using a Multimeter.
3.	To design a switch (NOT gate) using a transistor.
4.	To verify and design AND, OR, NOT and XOR gates using NAND gates.
5.	Half Adder ,Half Subtractor and 4-bit Binary Adder
6.	To study V-I characteristics of P-N junction ,Zener and Light emitting diode.
7.	To study the characteristics of a Bipolar Junction Transistor in CE configuration.
8.	To study the frequency response of voltage gain of a RC-coupled transistor amplifier.
9.	To design Inverting amplifier using Op-amp (741) and study its frequency response.
10.	To design an Astable Multivibrator using IC 555 Timer .
11.	To design a precision a Differentiator using an Op-Amp 741.

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Suggested Readings :

1. Electronic Principles & Applications: A.P.Malvino ,D.P.Leach and Saha(McGraw Hill).
2. Modern Digital Electronics- R.P.Jain ,Tata McGraw Hill,4th Edition.
3. Principles of Electronics:-V.K.Mehta& Rohit Mehta(s.Chand& Comp).
4. Basic Electronics Devices :-D.P.Kothari& I J Nagrath(McGraw Hill Educ).
5. Hand Book of Electronics-Gupta & Kumar.
6. Foundation of Electronics - Chattopadhyay; Rakshit;Saha;Purikait(Wily).

Semester – VI

MJCPHY10: Analytical Mechanics & Special Theory of Relativity

Course Title	Credit	Credit Distribution	
		Theory	Practical
Analytical Mechanics & Special Theory of Relativity	4	4	0

Course Outcomes

After completion of the course, the students will be able to :

CO1: Understand Physical Principle behind derivation of Lagrange and Hamiltonion Equation.

CO2: Understand Canonical Transformation

CO3: Analysis the Centre of mass and Laboratory frames of reference and their use in explaining elastic and inelastic collisions

CO4: Understand the Planetary motions and motions of satellites using the principles of gravitation and Kepler's laws. Getting an idea of postulates of special theory of relativity and their implications.

CO5: Get background for further studies and research in different subject areas.

MJCPHY10:	Analytical Mechanics & Special Theory of Relativity (T) - 4 Credit	
Unit	**Topics to be covered**	**No. of Lectures**
1	**Constrainsts :** Holonomic, Non Holonomic, Scleronomous, Rheonomous, D'Alembert's Principle, Virtual Displacement, Principle of virtual work, concept of generalized co-ordinates, Derivation of Lagrange's equation from D'Alembert's Principle , simple applications of Lagrange's equations. **Variational Principle and Hamiltonian formalism:** Calculus of variation and its applications, Hamilton's Principle, Derivation of Lagrange's equations of motion from Hamilton's Principle, Velocity-dependent potential, Cyclic coordinates, Symmetries and conservation laws, Legendre transformation, Hamilton's equations of motion and its applications, Principle of least action.	15

2	**Canonical Transformation:** Canonical transformation and its applications, Poisson Brackets, Jacobi identity, Hamilton-Jacobi equation, Action-angle variables, Theory of small oscillations.	10
3	**Motion of a Rigid body :** Euler's Angle, Kinematics of rotation, Euler's equation of Motion, Twisting Torque on a Elastic Cylinder.	08
4	**Special Theory of Relativity:** Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Lorentz contraction. Time dilation. Relativistic addition of velocities. Variation of mass with velocity. Mass less Particles. Mass-energy Equivalence Four vectors.	15
	TOTAL	**48**

Suggested Books :

1. An introduction to mechanics - Kleppner D., Kolenkow R. J. (McGraw-Hill)
2. Mechanics, Berkeley Physics, vol.1 - Kittel C., Knight W., et.al. (Tata Mc Graw - Hill)
3. Physics - Resnick, Halliday and Walker ,Wiley (8/e)
4. Cengage Learning - Fowles G. R. and Cassiday G.L...
5. Sands M.Feynman Lectures,Vol. I- FeynmanR. P., Leighton R. B. (Pearson Education)
6. Mechanics - Mathur D. S. , S.Chand (Company Limited)
7. Special Relativity - B.C. Rai
8. University Physics - Sears F. W, Zemansky M. W., Young H.D... 13/e (Addison Wesley)
9. Physics for scientists and Engineers with Modern Phys. - JewettJ. W., Serway R. A. (Cengage Learning)
10. Theoretical Mechanics - Spiegel M.R. (Tata McGraw Hill)
11. Special Theory of Relativity - S. Chand.
12. Relativity - Gupta & Kumar (Pragati Prakashan)

SEMESTER-VI

MJCPHY11: Statistical Mechanics

Course Title	Credit	Credit Distribution	
		Theory	Practical
Statistical Mechanics	5	5	0

Course Outcomes

After the completion of the course, the student will be able to:

CO1: Basic knowledge of thermodynamic systems.

CO2: Understand the basic idea about statistical distributions.

CO3: Impart the knowledge about the phase transitions and potentials.

CO4: Understand the applications of statistical laws

CO5: Get background for further studies and research in different subject

MJCPHY11: Statistical Mechanics (T) - 5 Credit		
Unit	**Topics to be covered**	**No. of Lectures**
1	**Classical Statistics** Macrostate and Microstate, Phase Space, Elementary Concept of Ensemble, Entropy and Thermodynamic Probability. Maxwell-Boltzmann Distribution Law, Partition Function, Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression, Gibbs Paradox, Sackur-Tetrode equation, Law of Equipartition of energy, its applications to Specific Heat and its Limitations.	15
2	**Classical Theory of Radiation** Black Body Radiation, Kirchhoff's law, Stefan-Boltzmann law(Thermodynamic proof), Radiation Pressure. Wien's Displacement Law. Wien's Distribution Law. Saha's Ionization Formula. Rayleigh-Jean's Law. Ultraviolet Catastrophe.	10
3	**Quantum Theory of Radiation** Spectral Distribution of Black Body Radiation. Planck's Quantum Postulates. Planck's Law of Blackbody Radiation: Experimental verification. Deduction of (1) Wien's Distribution Law (2) Rayleigh-Jeans Law, (3)Stefan-Boltzmann Law, (4) Wien's Displacement Law from Planck's Law.	10
4	**Bose-Einstein Statistics** Bose-Einstein distribution law, Thermodynamic functions of a strongly Degenerate Bose Gas, Bose Einstein condensation, Properties of liquid He (qualitative description), Radiation as a photon gas and Thermodynamic functions of photon gas. Bose derivation of Planck's law.	10

5	**Fermi-Dirac Statistics** Fermi-Dirac Distribution Law, Thermodynamic functions of a Completely and strongly Degenerate Fermi Gas, Fermi Energy, Electron gas in a Metal, Specific Heat of Metals, Relativistic Fermi gas, Chandrasekhar Mass Limit.	15
	TOTAL	**60**

Suggested Readings:

1. Statistical Mechanics, R.K. Patharia, Butterworth Heinemann: Oxford University Press.
2. Statistical Physics, Berkeley Physics Course, F. Reif, Tata McGraw-Hill.
3. An Introduction to Statistical Mechanics & Thermodynamics, R. H. Swendsen, Oxford Univ. Press.
4. Kersan Huang, Wiley India Pvt. Ltd.
5. Statistical Mechanics, Agrawal & Eisner, Wiley Ind. Pub.
6. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, (Springer).

SEMESTER-VI

MJCPHY12: Quantum Mechanics & its Application

Course Title	Credit	Credit Distribution	
		Theory	Practical
Quantum Mechanics & its Application	5	3	2

Course Outcomes

After the completion of the course, the student will be able to:

CO1: Learn to represent quantum states by ket vectors, physical observables as operators and their time evolution.

CO2: Understand commutator brackets between observables and their properties.

CO3: Learn concept of system of identical non- interacting particles: dynamics of two level systems, qubits.

CO4: Get background for further studies and research in different subject

MJCPHY12: Quantum Mechanics & its Application (T) - 3 Credit		
Unit	**Topics to be covered**	**No. of Lectures**
1	**Wave-Particle duality** Need of quantum mechanics, de Broglie's theory of matter wave, concept of Wave Packet, Fourier transform and momentum -space wave function. Postulates of quantum mechanics,Explanation of Heisenberg's Uncertainty relation	05
2	**Time Independent Schrodinger Wave Equation** Derivation of Time independent Schrodinger wave equation, Physical intrepation of wave function. Application of Time independent Schrodinger wave equation in case of Hydrogen atom, Linear harmonic oscillator.PotentialWell,Potential Barrier	10
3	**Formalism of Quantum Mechanics** Hilbert Space and Concept of Ket and Bra notations, Representation of position operator in momentum space. Representation of momentum -operator in position space,Representation of eigen-state vector in momentum space and position space.	10
4	**Time Dependent Schrodinger Wave Equation** Dynamical evolution of a quantum state, Properties of time-development operator, Derivation of dynamical equation for an operator of a quantum system and its Consequences. Comparative Study of Schrodinger picture, Heisenberg picture and interaction picture.	10

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5	**Angular Momentum Operator** Orbital Angular momentum operator and its Commutation relation, Spin angular momentum operator and Pauli's spin matrices. Commutation relation of Pauli's spin matrices, ladder operator for total angular momentum operator and its Commutation relation, Spin-Orbit Coupling in atoms(L-S and J-J coupling),Bohr Magneton	10
	TOTAL	**45**

MJCPHY09:	**Quantum Mechanics & its Application (P) - 2 Credit**
1.	Solve the Schrodinger equation for the ground state & the 1st excited state of Hydrogen atom.
2.	Solve the Radial equation for an atom.
3.	Estimate the Energy values of Linear harmonic oscillator with the given data.
4.	Estimate the Energy values in Potential Well having defined with & depth.
5.	Estimate the allowed Energy values of given Potential Barrier.

Suggested Readings :

1. Quantum Mechanics, Eugen Merzbacher, John Wiley and Sons, Inc.
2. Quantum Mechanics, G. P. Singh, (Pub: Bharti Bhavan)
3. Quantum Physics, H. C. Verma, (Pub: Surya Publication)
4. Introduction to Quantum Mechanics, David J. Griffith, Pearson Education
5. Quantum Mechanics, Walter Greiner, Springer
6. Quantum Mechanics, Bruce Cameron Reed, Jones and Bartlett Learning.
7. A Text book of Quantum Mechanics, P. M. Mathews and K.Venkatesan, McGraw Hill.
8. Quantum Mechanics, Leonard I. Schifi, Tata McGraw Hill.
9. Principle of Quantum Mechanics, Ishwar Singh Tyagi, Pearson Publication.

SEMESTER – VII

MJCPHY13: Physics of Atoms and Nuclei

Course Title	Credit	Credit Distribution	
		Theory	Practical
Physics of Atoms and Nuclei	5	3	2

Course Outcomes

After the completion of the course, the student will be able to understand:

CO1: To understand the idea of spectra of one and two valence electron atoms.

CO2: To understand the effect of external fields on spectral lines

CO3: To understand the concept of vector atom model.

CO4 To understand the structure of nucleus

CO5: To promote interdisciplinary research in spectroscopy and element analysis

CO6: Get background for further studies and research in different subject

MJCPHY13: Physics of Atoms and Nuclei (T) - 3 Credit		
Unit	**Topics to be covered**	**No. of Lectures**
1	**H-spectra** Fine structure of hydrogen spectra (H_α-line), Wilson-Sommerfeld quantization rule, Problems related to Bohr theory, Bohr-Sommerfeld theory and Ionization Potentials, Bohr-Sommerfeld (B-S) theoretical explanation of fine structure H-spectra, shortcomings of B-S theory, Stern-Gerlach Experiment to demonstrate the existence of electron spin, Difference between spectra of inner core electron (X-ray spectra) and optically active valence electron (UV-Visible and I.R. Spectra).	10
2	**Quantum mechanics of H-atom** Physical interpretation and properties of wave-function, Quantum mechanical treatment of one-electron atomic system (Hydrogen atom).Solution of Schrodinger equation for Hydrogen atom using separation of variables, Associated Legendre Polynomial,Hypergeometric series, Recurrence Formula, Spherical Harmonics,Interpretation of quantum numbers and electron-probability density, Expectation value and parity of eigenfunctions.	10

3	**Concept of Vector Atom model** Orbital magnetic dipole moment, Behaviour of magnetic dipole in external magnetic field, Larmor Precession, Space quantization, coupling of orbital and spin angular momentum, Spectroscopic term and their notations. Lamb Shift, Pauli's Exclusion Principle and wave function for identical particle system, Zeeman effect and Paschen Back effect for one electron system	08
4	**Spectra of 1 and 2 electron system (Alkali and Alkaline Earth Element)** Feature and explanation of Spectra of Alkali elements, Resonance lines and fine structure in Alkali spectra, Intensity ratio of Na- doublet lines, Interaction energy for L-S and J-J coupling for Alkaline Earth elements.	10
5	**Nuclear Models** Essence of Liquid drop model, Salient Features and Predictions of Shell model, Brief idea of Collective Model, Alpha particle model and Fermi gas model, Nuclear reaction and its types, Artificial Transmutation, Experimental determination of Q-value, Deuteron problem and its wavefunction, Central force and Non-Central force, Yukawa's model and π-meson.	10
	TOTAL	**48**

MJCPHY13:	**Physics of Atoms and Nuclei (P) - 2 Credit**
1. To determine e/m by Millikan's oil drop method. 2. To draw the plateau curve for a GM count. 3. To study Zeeman Effect 4. To study specture of simple atoms. 5. To study H-line 6. To study Arc-Spectrum and its simulation Experiments.	

Suggested Readings :

1. Physics of atoms and Molecule – Bransden & Jochain (Pearson)
2. Atomic and molecular Physics: Raj kumar (Kedarnath & Ram Nath)
3. Concepts of Nuclear Physics by B L Cohen, Tata McGraw Hill Publication
4. Physics and Engineering of Radiation Detection by S N Ahmed, Academic Press Elsevier,
5. Nuclear Physics: Roy & Nigam (Wiley Easter Ltd.) - John Lilley (Willy Indian.)

SEMESTER – VIII

MJCPHY14: **Research Methodology**

Course Title	Credit
Research Methodology	5

The Paper will be common for all students of faculty of Science. There is a common Syllabus for MJC – 14, already done.

SEMESTER – VII

MJCPHY 15: Solid State Physics

Course Title	Credit	Credit Distribution	
		Theory	Practical
Solid State Physics	6	4	2

Course Outcomes

After the completion of the course, the student will be able to:

CO1: Elucidate the concept of lattice, crystals and symmetry operations.

CO2: Understand the elementary lattice dynamics and its influence on the properties of materials.

CO3: Describe the main features of the physics of electrons in solids: origin of energy bands, and their influence electronic behavior.

CO4: Explain the origin of the dielectric properties exhibited by solids and the concept of polarizability.

CO5: Get background for further studies and research in different subject

MJCPHY15:	Solid State Physics (T) - 4 Credit	
Unit	**Topics to be covered**	**No. of Lectures**
1	**Crystal Structure:** Solids: Amorphous and Crystalline Materials, Lattice and Basis, Bravais Lattices. Lattice Translation Vectors, Types of Bravais Lattices, Unit Cell. Miller Indices. Reciprocal Lattice, Brillouin Zones, Diffraction of X-rays by Crystals. Bragg's Law.	12
2	**A. Crystal Bonding:** Elementary idea of Bonding in Solids, Cohesive Energy of Ionic Crystals, Lennard Jones Potential. **B. Elementary Lattice Dynamics:** Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains, Acoustical and Optical Phonons, Dulong and Petit's Law, Einstein theory Debye theory of specific heat of solids, T^3— law.	12
3	**A. Free Electron Theory**: Theory of free electron gas, Fermi surface, Fermi Energy, Density of States. **B. Elementary Band Theory:** Bloch Theorem. Kronig-Penny Model, Band Gap, Conductor, Semiconductor (P and N type) and insulator. Conductivity of Semiconductor, Measurement of conductivity (Four Probe Method), Mobility, Hall Effect & Hall coefficient.	12
4	**A. Magnetic Properties of Matter:** Origin of magnetism, Langevin's theory of Diamagnetism and Paramagnetism. Ferromagnetism and Antiferromagnetism. Curie-Weiss law, Ferromagnetic Domains.	12

	B. Superconductivity: Critical Temperature. Critical Magnetic Field, Meissner effect. Type Iand Type II Superconductors, London's Equation and Penetration Depth. Isotope effect, Idea of BCS theory(Basic Concept). **C. Dielectric Properties of Materials:** Polarization. Local Electric Field at an Atom, Depolarization Field, Electric Susceptibility, Polarizability, Clausius-Mossotti Equation.	
	TOTAL	**48**

MJCPHY15:	**Solid State Physics (P) - 2 Credit**
Practical	
1.	Measurement of susceptibility of paramagnetic solution (Quinck's Tube Method)
2.	To measure the Magnetic susceptibility of Solids.
3.	To determine the Coupling Coefficient of a Piezoelectric crystal.
4.	To measure the Dielectric Constant of a dielectric Materials with frequency
5.	To determine the complex dielectric constant and plasma frequency of metal using Surface Plasmon resonance (SPR).
6.	To determine the refractive index of a dielectric layer using SPR.
7.	To study the PE Hysteresis loop of a Ferroelectric Crystal.
8.	To draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis.
9.	To measure the resistivity of a semiconductor (Ge) with temperature by four-probe method (room temperature to 150°C) and to determine its band gap.
10.	To determine the Hall coefficient of a semiconductor sample.

Suggested Readings :

1. Introduction to Solid State Physics, Charles Kittel, Wiley India Pvt. Ltd.
2. Elements of Solid State Physics, J.P. Srivastava, Prentice-Hall of India.
3. Introduction to Solids, Leonid V. Azaroff, Tata Me-Graw Hill.
4. Solid-state Physics, H. Ibach and H. Luth, Springer.
5. Solid State Physics – R. L. Singhal, P.A. Alvi, (KedarNath, RamNath), M.A. wahab (Nurosa), S.O Pillai (New Age Pub.
6. www.youtube.com/distinctphysics - Lecture videos.

SEMESTER – VIII

MJCPHY16: Physics of Laser and Molecules

Course Title	Credit	Credit Distribution	
		Theory	Practical
Physics of Laser and Molecules	4	3	1

Course Outcomes

After the completion of the course, the student will be able to:

CO1: To understand the working of LASER- Sources.
CO2: To understand the applications of different types of LASER in day to day life.

CO3: To understand the concept of formation of Molecule
CO4: To understand the mechanism of spin Resonance Spectroscopy
CO5: To learn the working of Opto-electronic and Photonic devices

CO6: To enhance the employability in the field of optics
CO7: To explore research in the area of photonics
CO8: Get background for further studies and research in different subject

MJCPHY16: Physics of Laser and Molecules (T) - 3 Credit		
Unit	**Topics to be covered**	**No. of Lectures**
1	Basic Theory of LASER: Energy levels and process of Absorption and Emission Einstein's Predication, Difference between spontaneous and stimulated emission Important features of stimulated emission Einstein's A and B Co-efficient,Light Amplification condition for enhanced stimulated emission, population inversion and pumping method and schemes (two level, three level and four level): Amplifier and Optical Resonator with threshold condition for Lasing.	12
2	Application of LASER in Holography,Concept of Temporal and Spatial Coherence, Principle method of generating and observing hologram, types of holograms. Application in consumer electronic industry (Barcode reader and its elements), in communication-basic principle and element of optical fiber communication. Numerical aperture of fiber optics cables. In medical science, LASER diagnostics, LASER in ophthalmology and LASIK, LASER-surgery and LASER in Dermatology.	14
3	Concept of molecule, Basic idea of molecular bonding-Ionic Non-Rigid rotator and covalent formation of molecules, Morse potential energy curve, Molecule as oscillator, Concept of dissociation, wave function of H_2^+ Valence bond, Linear Combination of Atomic Orbitals (L.C.A.O.) concept.	10

4	Hamiltonian of molecule theory, Separation of electronic and nuclear motion (Born-oppenheimer approximation), Types of molecular energy states-vibrational, rotational and electronic, Types of molecular spectra-UV, IR, Raman; flame spectroscopy and flame photometry, X-Ray and Mossbauer spectroscopy.	12
5	Different Molecular spectroscopic techniques as a Tool- atomic absorption spectroscopy, Emission spectroscopy, Molecular Luminescence, Photo and Opto-acoustic spectroscopy (PAS/OAS), Nuclear Magnetic Resonance (NMR), Nuclear Quadrupole Resonance (NQR), Electron Spin Resonance (ESR) and Electron diffraction spectroscopy.	12
	TOTAL	**60**

MJCPHY16: Physics of Laser and Molecules (P) - 1 Credit	
1.	To verify Beer-Lambert law
2.	To detect impurity in given sample using spectrophotometer
3.	To determine speed light in air in Lab
4.	To calculate / evaluate the Numerical aperture of given fiber
5.	To use basic Transmission network using Demonstration Kit.
6.	To study Characteristics of LASER .
7.	To study UV/IR- Spectrum of given sample.

Suggested Readings :

1. Quantum Chemistry- R.K.Prasad (New Age International (P) Ltd.)
2. Physics of Atoms and Molecules B H Bransden and C J Joachain
3. Molecular Structure & Spectroscopy – G. Aruldhas (PHI)
4. Molecular Spectroscopy - B.K Sharma (Goel Publishing House)
5. Lasen Principle : Types & Application - K.R. Nambia (New Age Publication)
6. Laser & Opticals – L.V. Tarasor (Mir)7. Introduction Laser : Theroy & Application – M.N. Avdhanulu & P.S Hemne (S.Chand)

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SEMESTER- III

MICPHY03: Thermal Physics &Thermodynamics

Course Title	Credit	Credit Distribution	
		Theory	Practical
Thermal Physics &Thermodynamics	3	2	1

Course Outcomes

After the completion of the course, the student will be able to:

CO1: Comprehended the basic concepts of thermodynamics, the first and the second law of thermodynamics.

CO2: Understand the concept of entropy and the associated theorems, the thermodynamic potentials and their physical interpretations.

CO3: Learn about Maxwell's relations and use them for solving many problems in Thermodynamics.

CO4: Learn the basic aspects of kinetic theory of gases, Maxwell-Boltzmann distribution law, equitation of energies, mean free path of molecular collisions, viscosity, thermal conductivity, diffusion and Brownian motion.

MICPHY03: Thermal Physics &Thermodynamics (T) -2 Credit		
Unit	**Topics to be covered**	**No. of Lectures**
1	**Kinetic Theory of Gases** Maxwell-Boltzmann Molecular Speed distribution Law for an Ideal Gas. Mean, RMS and Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy (no derivation). Molecular Collisions: Mean Free Path. Estimation of Mean Free Path. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian motion, Langevin and Einstein's theories and experimental determination of Avogadro's no., Rectilinear flow of heat in a metal rod, relation between thermal & electrical conductivities.	10
2	**Real Gases** Behavior of Real Gases. Van der Waal's Equation of State for Real Gases. Values of Critical Constants. Law of Corresponding States. Joule-Thomson Porous Plug Experiment. Joule-Thomson Effect for Real Gases. Joule-Thomson Cooling.	08
3	**Zeroth and First Law of Thermodynamics** Extensive and intensive Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics and Concept of Temperature, Work, Heat, State Functions and path functions, First Law	05

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	of Thermodynamics, Internal Energy for ideal and real gases, Applications of First Law of thermodynamics in case of thin film, stretched wire, hydrostatics, and specific Molar Heat Capacity for gases, Specific heat General Relation between C_P and C_V.	
4	**Second Law of Thermodynamics** Cyclic ,reversible and irreversible process, Carnot engine, Carnot cycle, Principle of Refrigerator. Second Law of thermodynamics.Principal of heat engine and refrigerator Kelvin-Planck and Clausius Statements. Concept of Entropy, Clausius Inequality, Second Law in terms of Entropy, Temperature–Entropy diagrams. Third Law of thermodynamics, Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz & Gibb's Functions, Maxwell's Relations, Co-efficient of performance, Clausius-Clapeyron equation and phase transition (1^{st} and 2^{nd})	07
	TOTAL	**30**

MICPHY03:	**Thermal Physics &Thermodynamics (P) -1 Credit**
1.	To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2.	To determine the Coefficient of Thermal Conductivity of good conductor (Cu) by Searle's Apparatus.
3.	To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).
4.	To study the variation of Thermo-emf of a Thermocouple with Difference of Temperature of its Two Junctions using a null method.
5.	To determine Mechanical Equivalent of Heat, J, with the help of Joule's calorimeter.
6.	To plot a graph between temperature and pressure at constant volume using Joly's apparatus and to find the coefficient of increase of pressure at constant volume.

Suggested Readings :

1. Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
2. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
3. A Treatise on Heat, MeghnadSaha, and B.N. Srivastava, 1958, Indian Press
4. Classical and Quantum Thermal Physics, R. Prasad, 2016, Cambridge University Press
5. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
6. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988,Narosa
7. Thermal Physics ,Thermodynamics S.C Garg, R.M Bansal& C. K .Ghosh
8. Theory and Experiment on Thermal Physics: P.K.Chakrabarti, New Central Book Agency (p) Ltd
9. Thermodynamics: J.P Aggrawal & Satya Prakash
10. Advanced Practical Physics for students: B. L. Flint and H.T.Worsnop (Little Hampton Book)
11. B.Sc. Practical Physics :C.L.Arora (S.Chand)
12. Practical Physics: G.L. Squires (Cambridge University Press)

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SEMESTER- IV

MICPHY04: Electricity & Magnetism

Course Title	Credit	Credit Distribution	
		Theory	Practical
Electricity & Magnetism	3	2	1

Course Outcomes

After the completion of the course, the student will be able to:

CO1: Understand the basic concepts of electrostatics.

CO2: Understand the dielectric properties of matter.

CO3: Understand the electromagnetic induction and electrical circuits.

MICPHY04: Electricity & Magnetism (T) -2 Credit		
Unit	**Topics to be covered**	**No. of Lectures**
1	**Electrostatics:** Coulomb's law. Electric Field and potential, Field due to a uniformly charged sphere, Gauss's Law and its application: Electric dipole, Field and potential due to an electric dipole, Electrostatic Energy of a uniformly charged sphere, Energy of a condenser.	08
2	**Dielectric Properties of Matter:** Electrical susceptibility and Dielectric constant, Polarization, Electronic polarization, Atomic or ionic Polarisation, Surface Charge and bound charge, Displacement Vector **D**, Relations between **E**, **P** and **D**	06
3	**Magnetism:** Magnetic field , Magnetic force on a current carrying conductor placed in a uniform magnetic field, Biot – Savart's Law and its simple applications: straight wire and circular loop, Magnetic Dipole, and Ampere's Circuital law. Gauss's law of magnetism (Integral and Differential Forms). Magnetization current. Relative Permeability of a Material. Magnetic Susceptibility. Magnetization Vector (**M**), Magnetic Intensity (**H**), Relation between **B**, **M** and **H**. **Electromagnetic Induction:** Faraday's and Lenz's Laws. Mutual and Self Induction and their determination for a solenoid. Energy stored in a Magnetic Field, Induced magnetic field (Time varying electric field).	10

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4	**Electrical Circuits:** AC Circuits: Kirchhoff's laws for AC circuits. Reactance and Complex Impedance. Series and parallel LCR Circuit: (1) Resonance, (2) Quality Factor, and (3) Band Width. Power in AC Circuits.	06
	TOTAL	**30**

MICPHY-04	**Electricity and magnetism (P)-1 Credit**
1.	Use of Multimeter for measuring (a) Resistance, (b) AC and DC Voltages, (c) DC Current, (d) Capacitance, and (e) Checking electrical fuses.
2.	To calibrate the ammeter and voltmeter by potentiometer.
3.	To find the low resistance by Carey Foster's bridge after calibrating the bridge wire.
4.	Measurement of low resistance using Potentiometer.
5.	Figure of merit of moving coil galvanometer.
6.	To determine the angle of dip in the laboratory using an earth inductor.
7.	Compare the capacities of capacitors by De Sauty' bridge.
8.	To verify the Thevenin and Norton theorems.
9.	To verify the Superposition, and Maximum power transfer theorems.
10.	To determine self inductance of a coil by Anderson□s bridge.
11.	To study the response curve of a Series LCR circuit and determine its

Suggested Readings:-

1. Electricity and Magnetism, Basudev Ghosh (Books And Allied (P) Ltd
2. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
3. Electricity ad Magnetism
4. Fundamentals of Electricity and Magnetism, Arthur F. Kip, 2nd Edn.1981, McGraw-Hill.
5. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw-Hill
6. Fundamentals of Electricity and Magnetism D.N Vasudev (S. Chand & Co)
7. Electricity and Magnetism- R. Murugeshan (S. Chand)
8. Electricity and Magnetism-K.K. Tiwari (S. Chand)

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SEMESTER-V

MICPHY-05: Mathematical Physics-II and Introduction to Computational Methods

Course Title	Credit	Credit Distribution	
		Theory	Practical
Mathematical Physics-II and Introduction to Computational Methods	03	02	01

Course Outcomes

After the completion of the course, the student will be able to:

CO1: Master the basic elements of complex mathematical analysis.

CO2: Solve differential equations that are common in physical sciences.

CO3: Apply group theory and integral transforms to solve mathematical problems of interest in Physics.

CO4: Understanding how to use special functions in various physics problems

CO5: Provides background for further studies and research in different subject areas .

MICPHY05: Mathematical Physics and Introduction to Computational Methods (T) -2 Credit		
Unit	**Topics to be covered**	**No. of Lectures**
1	**Curvilinear Coordinates, Tensors and special functions:** Spherical and Cylindrical Coordinate Systems. Ordinary Integrals of Vectors, Line, surface and volume integrals of Vector fields. Second Order Linear Differential Equation and its solution using Frobenius method.	06
2	**Partial Differential Equations:** Solutions to partial differential equations using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry.	06
3	Introduction: Importance of Computers in Physics, Algorithms and Flow Charts: Algorithm Definition, properties and development. Flowchart:	06

	concept of flowchart , symbols , guidelines, types.	
4	Scientific Programming: Basic ideas of Linux, some fundamental Linux commands (Internal & External commands), FORTRAN: Basic ideas for development of FORTRAN Programming. Layout of FORTRAN programs, writing of simple FORTRAN programs and concept of coding.	06
5	Control statements :Introduction of Subscripted variables, Functions and Subroutines (Arithmetic statements, Function, Function subprogram and subroutine), and their usage in programs of simple Physics Problems.	06
	Total	**30**

MICPHY05: Mathematical Physics and Introduction to Computational Methods (P) -1 Credit
Practical
1. Errors & error Analysis: Truncation & rounding of errors, absolute & relative errors.
2. Differential equations: Solutions of ordinary differential equation, solution of first order differential equation, solution of quadratic equation.
3. **Programs:** Sum & average of a list of numbers, Largest of a given list of numbers, Familiarity with DOS commands, Linux Commands and FORTRAN commands.

Suggested Readings:-

1. Introduction to Numerical Analysis: S. S Sastry
2. Mathematical Methods for Scientists & Engineers: D.A. McQuarie (Pub. Viva Books)
3. An Introduction to Computational Physics: T. Pang (Cambridge University Press)
4. Numerical Recipes in C: The Art of Scientific Computing, W.H.Pressetal (Cambridge University)

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SEMESTER- V

MICPHY-06: Electrodynamics and Electromagnetism

Course Title	Credit	Credit Distribution	
		Theory	Practical
Electrodynamics and Electromagnetism	3	3	0

Course Outcomes

After completing the course, the students will be able to:

CO1: Establish and analyse four Maxwell's equations of electromagnetism.

CO2: Understand the propagation of electromagnetic waves in vacuum, dielectrics, conductors and also in guided media and the phenomenon of reflection and refraction of plane waves at different boundaries.

CO3: Understand the importance of energy flow(Poynting Theorem) and its usefulness.

MICPHY-06: Electrodynamics and Electromagnetism (T) -02 Credit		
Unit	**Topics to be covered**	**No. of Lectures**
1	**Equations:** Equation of continuity, Maxwell's equations in differential and Integral forms; Vector and scalar potentials.Poyinting Theorem and Poynting Vector. Electromagnetic (EM) Energy Density. Physical Concept of Electromagnetic Field Energy Density.	07
2	**Electromagnetic Wave Propagation in unbounded media:** Propagation of plane EM waves in free space Transverse nature of plane EM waves, refractive index and dielectric constant, wave impedance. Propagation of EM wave through conducting media.	07
3	**EM Wave Propagation in Bounded Media:** Boundary conditions at a plane interface between two media. Reflection & Refraction of plane waves at plane interface between two dielectric media — Laws of Reflection & Refraction, Total internal reflection.	06

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4	**Polarization of Electromagnetic Waves:** Description of Linear, Circular and Elliptical Polarization. **Wave Guides:** Condition of continuity at interface. Phase shift on total reflection. Solution of wave equation in Rectangular waveguide, Eigenvalue equations. Expressions for field components (TE and TM modes). Propagation properties, cutoff frequency, group & phase velocity of guided waves. **Optical Fibres:** Numerical Aperture. Step and Graded Indices (Definitions Only). Single and Multiple Mode Fibres (Concept and Definition Only).	10
	TOTAL	**30**

Suggested Readings:-

1. Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings. ,
2. Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.
3. Introduction to Electromagnetic Theory, T.L. Chow, 2006, Jones & Bartlett Learning
4. Fundamentals of Electromagnetics, M.A.W. Miah, 1982, Tata McGraw Hill
5. Electromagnetic field Theory, R. S. Kshetrimayun, 2012, Cengage Learning r
6. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer
7. Electromagnetic Fields & Waves, P. Lorrain & D. Corson, 1970, W.H. Freeman & Co.
8. Electromagnetics, J. A. Edminster, Schaum Series, 2006, Tata McGraw Hill.

SEMESTER- VII

MICPHY 07: Optics

Course Title	Credit	Credit Distribution	
		Theory	Practical
Optics	3	2	1

Course Outcomes

After the completion of the course, the student will be able to:

CO1: Understand Interference as superposition of waves from coherent sources derived from same parent source.

CO2: Demonstrate basic concepts of Diffraction: Superposition of wavelets diffracted from aperture.

CO3: Understand Fraunhoffer and Fresnel Diffraction.

CO4: Gain experience of using various optical instruments and making finer measurements of wavelength of light using Newton's Rings experiment, Fresnel Biprism, etc.

MICPHY07:	Optics (T) -2 Credit	
Unit	**Topics to be covered**	**No. of Lectures**
1	**Interference:** Light as EM Wave(Historical Perspective),Superposition of waves, Conditions for interference, Interference by Division of Wavefront (Lloyd's single mirror) and by Division of Amplitude Newton's Ring, Stoke's treatment.	07
2	**Interferometer:** Michelson interferometer and its applications, Multiple beam interference in parallel film, Coherence – Spatial and Temporal.	06
3	**Fraunhofer Diffraction:** Conditions for diffraction, Fraunhofer diffraction due to single, Plane transmission grating. **Fresnel diffraction:** Fresnel half- period zones, Zone plate, Huygen's-Fresnel principle, Diffraction by a straight edge,Rayleigh's criterion for limit of resolution, Resolving power of Grating, Telescope.	08
4	**Polarization and Double Refraction:**	07

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	Polarized light and its mathematical representation, Production of polarized light by reflection, refraction and scattering, Polarization by double refraction, Nicol prism, Quarter wave plate, Half wave plate, Babinet's compensator, Production and analysis of circularly and elliptically polarized light. Elementary ideas of LASERs, Population Inversion and Holography.	
	TOTAL	**30**

MICPHY 07	**Optics (P) -1 Credit**

1. To determine Magnifying Power of a telescope by the Linear Scale.
2. To find the height of an inaccessible object (altitude or angular diameter of the Sun) using Sextant.
3. To find angle of prism/ angle of minimum deviation and hence refractive index of material of prism using Spectrometer.
4. To determine diameter of a thin wire by studying the diffraction (and interference) pattern.
5. To determine wavelength of sodium light using a plane diffraction grating.
6. To determine Resolving Power of a plane transmission grating.
7. Simple experiment demonstrating different applications of LASER and Optical Fibre.
8. Determination of wavelength of light using biprism on optical bench.
9. To determine the wavelength of the monochromatic light by Newton's Ring

Suggested Readings :

1. Optics(Classical & Quantum)-Dr. R.K.Kar(Books & Allied).
2. Optics:(2017), 6th Edition, Ajoy Ghatak, McGraw-Hill Education, New Delhi
3. Fundamental of Optics:Jenkins & White (Mc Graw Hill)
4. Fundamental of optics: B. K. Mathur,
5. A TextBook of Optics : N. Subrahmanyam, Brij V. Lal, M.N. Avadhanulu, S. Chand & Co Ltd
6. Practical Physics :Geetu Sunon(R.Chand& Company); Harnam Singh & P.S. Hemne(S.Chand& Co.)
7. A Text Book of Practical Physics: Indu Prakash, Ramakrishna&A.K.Jha, 11th Ed., 2011, Kitab Mahal
8. Advanced level Physics Practicals: Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
9. A Laboratory Manual of Physics for undergraduate classes:D.P.Khandelwal, 1985, Vani Pub.
10. Practical Physics: G.L. Squires, Cambridge University Press.
11. A Laboratory Manual of Physics – D.P.Khandewal.
12. Optics- Eugene Hecht(Pearson).

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SEMESTER – VI

MICPHY08: Elements of Modern Physics

Course Title	Credit	Credit Distribution	
		Theory	Practical
Elements of Modern Physics	3	3	0

Course Outcomes

After the completion of the course, the student will be able to:

CO1: Main aspects of the inadequacies of classical mechanics as well as understanding of the historical development of quantum mechanics.

CO2: Formulation of Schrodinger equation and the idea of probability interpretation associated with wave-functions.

CO3: The spontaneous and stimulated emission of radiation, optical pumping and population inversion. Three level and four level lasers. Ruby laser and He-Ne laser in details. Basic lasing.

CO4: The properties of nuclei like density, size, binding energy, nuclear forces and structure of atomic nucleus, liquid drop model and nuclear shell model and mass formula.

MICPHY08:	Elements of Modern Physics (T) – 3 Credit	
Unit	**Topics to be covered**	**No. of Lectures**
1	**Wave-Particle Duality** Hertz Experiment and Discovery of Photoelectric effect;Explanation of Photoelectric effect by Einstein; Wave nature of particle ;Historical perspectives of de Broglie's Matter wave; Heisenberg's Uncertainty principle	12
2	**Understanding Atom** Different Atomic models; alpha particle scattering experiment performed by Geiger and Marsden, Rutherford's nuclear Model of atom; Bohr's Model and specrum of hydrogen atom, Limitations of Bohr's Theory; Fine structure of H-lines	12
3	**Basic properties of atomic nucleus** Mass number,Mass Defect, Binding Energy.Binding Energy per nucleon versusMass Number Curve;Concept of Nuclear forces;Stability of Nucleus Radioactivity, Law of RadioactiviteDisintegration.Application of radioactivity in Carbon -Dating and Therapy	12
	TOTAL	**36**

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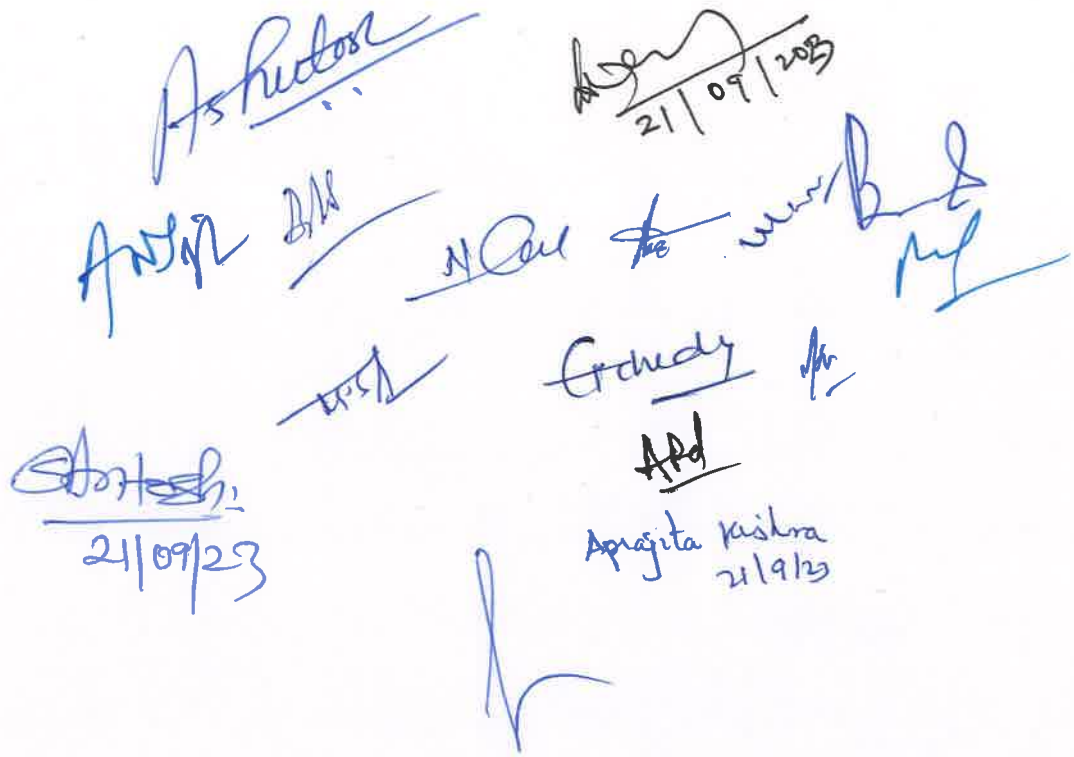
Suggested Readings :

1. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
2. Modern Physics by R ASerway, C J Moses and C A Moyer, 3rd edition, Thomson Brooks Cole, 2012.
3. Modern Physics for Scientists and Engineers by S T Thornton and A Rex, 4th edition, Cengage Learning, 2013.
4. Concepts of Nuclear Physics by B L Cohen, Tata McGraw Hill Publication, 1974.
5. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2ndEdn., 2002, Wiley.



SEMESTER – VII

MICPHY09: Basic Electronics

Course Title	Credit	Credit Distribution	
		Theory	Practical
Basic Electronics	4	3	1

Course Outcomes

After the completion of the course, the student will be able to:

CO1: Understand fundamental designing concepts of different types of Logic Gates, Minimization techniques etc.

CO2: Design of different types of the Digital circuits, and to give the computational details for Digital Circuits.

CO3: Draw characteristics of devices like PNP and NPN junction diode and truth tables of different logic gates.

CO4: Understand basic elements and measurement of their values with multimeter and their characteristic study.

MJCPHY 09	Basic Electronics (T) – 3 Credit	
Unit	**Topics to be covered**	**No. of Lectures**
1	**Digital Circuits:** Diffrence between Analog & Digital Circuits .BinaryNumbers.Decimal to Binary & vice-versa. AND,OR and NOT Gates(Realisation using Diodes & Transistors) NAND and NOR Gates as Universal gates.XOR Gates.	07
2	**Basic Circuit Operations:** De-Morgan's Theorem .Boolean Laws .Simplification of Logic Circuit using Boolean Algebra. Conversion of a Truth Table into an Equivalent Logic Circuit by (1) Sum of Products Method **Combinational circuits:** Basic Idea of Binary Addition. Binary Subtraction using 2's Complement. Half and Full Adders.	12
3	**Semiconductor Devices :** P-andN-type semiconductors. Energy Level Diagram. Barrier Formation in PN Junction Diode. Qualitative Idea of Current Flow Mechanism in Forward and Reverse Biased Diode.P-N junction & its characteristics.Static and Dynamic Resistance.Principle and structure of (1) LEDs (2) Photodiode (3) Zener Diode (4) Solar .Cell. **Electronic Devices and their Applications:** (1) Rectifier Diode: Half-wave Rectifiers. Full-wave Rectifiers (Centre-tapped and	10

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	Bridge), Calculation of Ripple Factor and Rectification Efficiency, (2) Voltage Regulation using Zener Diode. **Bipolar Junction transistors**:n-p-n and p-n-p Transistors, Characteristics of CB, CE and CC Configurations. Current gains α and β parameters, Relations between α and β parameters. Load Line analysis of Transistors. DC Load line and Q-point. Physical Mechanism of Current Flow: Active, Cutoff and Saturation Regions. **Amplifiers:** Transistor Biasing circuits and Stability. Fixed Bias and Voltage Divider Bias circuit for CE Amplifier. Input and Output Impedance. Current, Voltage and Power Gains. Class A	
4	**Sinusoidal Oscillations:** Feedback and Oscillation: Effects of Positive and Negative Feedback on Gain and Stability, Distortion and Noise. Sinusoidal Oscillators: Barkhausen's Criterion for self-sustained oscillations. RC andWien Bridge oscillator.	07
5	**Instrumentations:** Introduction to CRO:Block Diagram and Applications of CRO: (1) Study of Waveform (2) Measurement of Voltage ,Current ,Frequency and Phase Difference. **Power Supply:** Half Wave Rectifiers ,Centre-tapped and Full wave Rectifiers ,Calculation of Ripple Factor and Rectification Efficiency ,Basic Idea about capacitor filter , Zener Doide and Voltage Regulation.	09
	TOTAL	**45**

MICPHY 09	**Basic Electronics (P) – 1 Credit**
1.	To measure (a) Voltageand (b) Time period of a periodic waveform using CRO.
2.	To test a Diode and Transistor using a Multimeter.
3.	To design a switch (NOT gate) using a transistor.
4.	To verify and design AND, OR, NOT and XOR gates using NAND gates.
5.	Half Adder ,Half Subtractor and 4-bit Binary Adder
6.	To study V-I characteristics of P-N junction ,Zener and Light emitting diode.
7.	To study the characteristics of a Bipolar Junction Transistor in CE configuration.

Suggested Readings :

1. Electronic Principles & Applications: A.P.Malvino ,D.P.Leach and Saha(McGraw Hill).
2. Modern Digital Electronics- R.P.Jain ,Tata McGraw Hill,4th Edition.
3. Principles of Electronics:-V.K.Mehta& Rohit Mehta(s.Chand& Comp).
4. Basic Electronics Devices :-D.P.Kothari& I J Nagrath(McGraw Hill Educ).
5. Hand Book of Electronics-Gupta & Kumar.
6. Foundation of Electronics - Chattopadhyay; Rakshit;Saha;Purikait(Willey).

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Semester – VIII

MICPHY10: Analytical Mechanics & Special Theory of Relativity

Course Title	Credit	Credit Distribution	
		Theory	Practical
Introduction to Analytical Mechanics & Special Theory of Relativity	4	4	0

Course Outcomes

After completion of the course, the students will be able to:

CO1: Understand Physical Principle behind derivation of Lagranges and Hamiltonion Equation.

CO2: Understand problems in space science theoretical research

CO3: Analysis the Centre of mass and Laboratory frames of reference and their use in explaining elastic and inelastic collisions

CO4: Understand the Planetary motions and motions of satellites and Space science. Getting an idea of postulates of special theory of relativity and their implications.

MJCPHY10 Analytical Mechanics & Special Theory of Relativity (T) – 4 Credit		
Unit	**Topics to be covered**	**No. of Lectures**
1	**Rigid Body Motion:** Rigid body, Eulerian angles, Kinematics of rotation, Euler's equations of motion, Motion of a symmetrical top. **Variational Principle and Hamiltonian formalism:** Calculus of variation and its applications, Lagrange's equations of motion for non-holonomic system, Velocity-dependent potential, Cyclic coordinates, Symmetries and conservation laws, Legendre transformation.	14

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2	**Canonical Transformation:** Canonical transformation and its applications, Poisson Brackets, Jacobi identity, Hamilton-Jacobi equation.	08
3	**Collisions:** Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames.Elasticity: Review of relation between Elastic constants .	08
4	**Special Theory of Relativity:** Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Lorentz contraction. Time dilation. Relativistic addition of velocities. Variation of mass with velocity, mass energy equivalence	15
	TOTAL	**45**

Suggested Books :

1. Kleppner D., Kolenkow R. J. (1973).An introduction to mechanics,McGraw-Hill.
2. Kittel C, Knight W., et.al. (2007).Mechanics, Berkeley Physics, vol.1, Tata McGraw-Hill.
3. Resnick, Halliday and Walker (2008),Physics, Wiley, 8/e.
4. Fowles G. R. and CassidayG.L. (2005).Cengage Learning.
5. FeynmanR. P., Leighton R. B., Sands M. (2008). Feynman Lectures, Vol.I, Pearson Education.
6. MathurD. S. (2000). Mechanics,S. Chand and Company Limited.
7. SearsF. W, ZemanskyM. W., YoungH.D. (1986). University Physics. 13/e, Addison Wesley.
8. JewettJ. W., SerwayR. A. (2010). Physics for scientists and Engineers with Modern Phyε, Cengage Learning.
9. Spiegel M.R. (2006).Theoretical Mechanics, Tata McGraw Hill.
10. Special Theory of Relativity S.Chand
11. Gupta , kumar ,Pragati Prakashan

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Basket for Multidisciplinary Course (MDC)

Semester-III

Physics
• Acquaintance of Electrical and Electronic Appliances • Mesoscopic Materials • History And Philosophy Of Science • Sports Science • Atmospheric & Space Science • Physics Of Communication Technology

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Semester – III

MDCPHY- 3 Mesoscopic Materials

Course Title	Credit	Credit Distribution	
		Theory	Practical
Mesoscopic Materials	**3**	**3**	**0**

Course Outcome

- The Students will be able to understand
- the mysterious world of Mesoscopic materials
- comprehend the use of nano-structured materials in our daily life
- develop a multidisciplinary scientific logic and connect it to our day-to-day life
- the fascination of the diversity of mother nature

Unit 1 **(10 Hours)**

Mesoscopic sizes materials of bulk size materials of sub molecular sizes, sizes of nanometer range

Unit 2 **(10 Hours)**

Specialty in Physical Properties: Size dependents of physical properties like mechanical strength electrical conduction and magnetic properties of materials, applications of materials properties at Nanoscale

Unit 3 **(10 Hours)**

Mesoscopic materials in daily life: computers, Sensors, High-efficiency lasers and LEDs, ductile, ceramics drugs delivery

References:

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MDCPHY3: Acquaintance of Electrical and Electronic Appliances

Course Title	Credit	Credit Distribution	
		Theory	Practical
Acquaintance of Electrical and Electronic Appliances	3	3	0

Unit – I

Circuit Fundamental: **(10 Hours)**

Voltage, Current, Power, Work, Short circuit, open circuit, Ohm's Law.
Definition of Resistance, Capacitance, Inductance, Series Resistance, Parallel Resistance
Passive circuit Element, General, Resistors, types of Resistors, Resistors color code, SI unit, Checking Resistance with ohm meter.
Multimeter, components testing using a multimeter, Inductor, Inductance ofInductor, Mutual Inductance, SI unit. Capacitor, Capacitance, types of Capacitors, Cheeking capacitor with ohm meter.SI unit.

Unit – II **(10 Hours)**

Electronic Devices:
Diode, Transistor, LED, definition of symbol of these.
AC Circuit definition, Sine wave, DC current.
Power socket Identifying the phase, neutral, earth on power socket.
IC, PCB, bread Board, use a tester to monitor AC power, soldering, fuse definition, definition of an analog circuit, Decimal circuit,

Unit – III **(10 Hours)**

Hands on Training

- How to repair an electric cord
- Installing a new plug
- Disassembling the Fan
- How to repair electric Fan

Reference:
A Course in Electrical. & Electronics Measurements &Instrumentation-AK. Sawhney, (,Dhanpatrai & Co.) 1978

History and Philosophy of Science

Course Title	Credit	Credit Distribution	
		Theory	Practical
History and Philosophy of Science	**3**	**3**	**0**

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Subject Objective

- To introduce some fundamental issues in the history and philosophy of science
- To provide some understanding of the general principles of scientific thinking and methodology.
- To aim at understanding and debating what is meant by scientific enterprise
- To explore the connection between history, science and philosophy.

Expected Outcome

The Student will be able to learn

- Scientific method, reasoning, truth and evidence
- The contrast between empirical facts and philosophical facts.
- The change from Aristotelian worldview to the Newtonian worldview
- The recent developments in science especially relativity theory and evolutionary theory

Unit 1: Fundamental Issues **(06)**

What is science? , Science and its difference from other systems of belief and knowledge; science as a profession; difference between pure science and technology. Falsifiability, Instrumentalism and realism, problems and puzzles of Induction

Unit 2: Science & Technology: from the Aristotle to the Newton **(12)**

Greek Science. Seventeenth - century attack on Aristotelian Philosophy. Logical Reconstructionist, Philosophy of Science, Astronomical Data: The Philosophical Facts, The Ptolemaic System, The Copernicus System, Kepler's System, Galileo, Philosophical and conceptual connections in the Development of the New Science, Scientific Law Development of the Newtonian worldview 1700-1900

Unit 3: Metaphysical foundations of Science : Recent Developments in Science and Worldviews **(12)**

David Hume and the problem of causation, Naturalism and Anti-naturalism, Realism and antirealism about scientific theories; scientific explanation; and laws of nature, Karl

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popper inductivism and falsificationism, Thomas s Kuhn Rationality in Paradigm Change, normal science and scientific revolutions, Feyeraband scientific rationality and irrationlity

The special Theory of relativity, the general theory of relativity, Overview of the theory of Evolution, Philosophical and conceptual implications of Evolution, Worldviews: concluding Thoughts.

Text Books:

[1] Okasha Samir, *Philosophy of Science: A Very Short Introduction*, Oxford: Oxford University Press, 2002.

[2] Richard DeWitt, *Worldviews: An Introduction to the History and Philosophy of Science*, Blackwell publishing, 2004.

[3] Chalmers A. F., *What Is This Thing Called Science?*, (3rd ed.) Buckingham: Open University Press, 1999.

[4] Christopher R. Hitchcock, *Contemporary Debates in the Philosophy of Science*, Blackwell, 2004.

[5] John Losee, *A Historical Introduction to the Philosophy of Science*, Oxford University Press, 2001.

[6] Hard M., A. Jamison, Hubris and Hybrids. *A Cultural history of Technology and Science*, Routledge, 2005.

[7] Peter Godfrey-Smith *Theory and Reality: An Introduction to the Philosophy of Science,* University of Chicago

Reference Books:

- Erickson, M, "Scientists and Scientific Communities" (Chapter 5) *Science, Culture and Society: Understanding Science in the 21st Century*, Cambridge: Polity, 2005.
- Hacking I., 'What is Scientific Realism?, in *Hacking, Representing and Intervening*, Cambridge: Cambridge University Press, 1983
- Popper K.R., Ch. 11, *Conjectures and Refutations*. Routledge & Kegan Paul.1963, pp. 253-292.
- Searle J., 'The Building Blocks of Social Reality' in Searle, *The Construction of Social Reality*, London: the Penguin Press, 1995, pp.1- 29.
- Shapin Steven, "Don't Let That Crybaby in Here Again," London Review of Books, September, 2000,

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MDCPHY3: Physics of Communication Technology

Course Title	Credit	Credit Distribution	
		Theory	Practical
Physics of Communication Technology	3	3	0

SEMESTER-III
MDCPHY-3 SPORTS SCIENCE

Course Title	Credit	Credit Distribution	
		Theory	Practical
SPORTS SCIENCE	3	3	0

Unit – 1: **(10 Hours)**

Measurement: Physical quantities. Standards and Units. International System of Units. Standards of time, length and mass. Precision and significant figures.

Newton's laws of motion: Newton's firstlaw. Force, mass. Newton's second law. Newton's third law. Mass and weight. Applications of Newton's laws.

Projectile motion: Shooting a falling target. Physics behind Shooting, Javelin throw and Discus throw

Unit 2: **(10 Hours)**

Conservation laws: Conservation of linear momentum, collisions — elastic and inelastic. Angular momentum. (Physics behind Carom, Billiards, Racing)

Centre of mass: Physics behind Cycling, rock climbing, Skating, Gravitation: Origin, Newton's law of gravitation. Archimedes's principle, Buoyancy (Physics behind swimming)

Unit 3: **(10 Hours)** Food and Nutrition: Proteins, Vitamins, Fat, Blood Pressure. Problems due to the deficiency of vitamins. Energy: Different forms of Energy, Conservation of mass-energy.

Physical exercises: Walking, Jogging and Running, Weight management.

Suggested Books:

1. Physics for Entertainment-Yakov Perelman, Createspace Independent Pub.
2. Physics Everywhere, Yakov Perelman - Prodinnova
3. Mechanics for Entertainment- Yakov Perelman – Prodinnova
4. Food Science- Sri Lakshami, New Age Publications
5. Physics, Resnick, Holiday and Krane, Wiley Student Edition
6. An introduction to the Physics of Sports-Vassilios McInnes Spathopoulos, Createspace Independent publishing Platform

Internet resources https://www.topendsports.com/biomechanics/physics.htm
https://www.real-world-physics-problems.com/physics-of-sports.html

Topics for Self Study: **https://www.real-world-physics-problems.com/physics-of-sports.html**
Archimedes Principle: Made EASY Physics in You tube

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SEMESTER III

Atmospheric & SPACE SCIENCE

Course Title	Credit	Credit Distribution	
		Theory	Practical
Atmospheric &SPACE SCIENCE	3	3	0

Objective: **(30 Hours)**

To understand the basics of atmospheric and space science dealing with the structure of atmosphere, and stellar objects.

Expected Outcome

After this course, students will be able to

understand the structure of atmosphere

deal with tools and techniques used for space observation,

familiarize with our solar system,

realize the idea of the formation, evolution and classification of starsand

develop an idea of nucleo-synthesis and formation of heavy nuclei and theories of the Universe

connect the multi-disciplinary nature of development in science and technology to enhance the capability of space observation

UNIT I **(10 Hours)**

Earth and its atmosphere

Earth as a planet of the solar system: origin and internal structure, crustal types, heat flow and temperature gradient.

Elementary concepts of weather and climate; structure and composition of the atmosphere, Passage of solar radiation through the atmosphere, Atmospheric Windows, emissivity, Absorption spectra of atmospheric gases.

UNIT II **(10 Hours)**

Introduction:

Perception of Space from early civilization to pre-telescopic era and post-telescopic era, Important International Organizations involved in Space Exploration.

Observation of Space through our eyes, its limitations, and further explorations through instrumental aids.

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Distance measuring units and Techniques for Distance Measurement, Use of Non-Optical Telescopes and its importance in space observation.

UNIT III **(10 Hours)**

Solar system, Star – Formation,Evolution and Classification

Formation of our Solar System, Origin and Fate ofour Sun and its source of energy, Solar Wind, Planets, Asteroids, Satellites and Comets.
Star Formation, Nucleo– Synthesis and Formation of Elements, Stellar Evolution and Stellar Remnants and Classification of Stars:Harvard Classification & Hertzsprung-Russel Diagram.

Suggested Books:

1. Astrophysics: A modern Perspective - K. S. Krishnaswami (New Age International)
2. Atmospheric Sciences: An introductory Survey -J.M. Wallace and P.V. Hobbs (Academic Press)
3. An Introduction to Astrophysics-Baidyanath Basu, T. Chattopadhyay, S. N. Biswas(PHI 2nd Eds.)
4. An Introduction to Atmospheric Radiation-K. N. Liou (Academic Press).

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