

**Minutes of the meeting of the Academic Committee of the Physics Department, Institute of Basic Sciences (Dr. B. R. Ambedkar University), Agra held on Saturday 29-04-2021**

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1. Minutes of Academic Committee held on 12-01-2021 have been confirmed. (Appendix-I)
2. As per the Govt. Order No. 401/70-3-2022 dated 09.02.2022 the National Education Policy 2020 (NEP-2020) is implemented in the Ph.D. Course of Physics from the session 2022-23. This GO with NEP-2020 rules and regulations is accepted by the Academic Committee/Board of study of Physics subject for Ph.D. course running in the Department/University. The detailed syllabus and ordinances for Pre-Ph.D. course work/PGDR is attached as **Appendix-II**.
3. As per the Govt. Order No. 401/70-3-2022 dated 09.02.2022 the National Education Policy 2020 (NEP-2020) is implemented in Post-Graduation (M.Sc. Physics) from the session 2022-23. This GO with NEP-2020 rules and regulations is accepted by the Academic Committee/Board of study of Physics subject for Post-Graduation (M.Sc. Physics) courses running in the Department/University Colleges. The detailed syllabus and ordinances for M.Sc. Physics are attached as **Appendix-III**.
3. As per the Govt. Order the National Education Policy 2020 (NEP-2020) Under-Graduate Course will be started in the Physics Department from the session 2022-23. This GO with NEP-2020 syllabus and ordinances is accepted for Under-Graduation course for Physics started in the Physics Department from the session 2022-23. The detailed syllabus and ordinances are attached as **Appendix-IV**.
4. The detailed procedure for running of under graduation course will be finalized with the other department of the subject with supervision of Dean Science.
5. The syllabus and Ordinance of Pre-Ph.D. Course work/PGDR is revised as per the National Education Policy 2020 (NEP-2020) (Appendix-V)
5. Recommendation of Panel of Examiners for Ph.D. Thesis evaluation of Ms. Shalini Dubey under the supervision of Prof. B.P. Singh is proposed. (Appendix-VI)
6. Recommendation of Panel of Examiners for Ph.D. Thesis evaluation of Mr. Rishi Kant Saxena under the supervision of Dr. K.Y. Singh is proposed. (Appendix-VII)

*joined online*  
**Prof. Sukhdev Rai**  
(External Expert)  
(Joined online)

*joined online*  
**Dr. S.N. Dolia**  
(External Expert)  
(joined online)

*Amishra*  
**Dr. Gaurang Mishra**  
(Local Expert)

*Sharma*  
*29.4.2022*  
**Prof. Bindu Shekhar Sharma**  
(Internal Member)

*29/4/22*  
**Prof. B.P. Singh**  
H.O.D. & Convener  
**Dr. B. P. SINGH**  
Professor & Head  
Department of Physics  
Institute of Basic Science, Khanda  
Dr. B.R. Ambedkar University, Agra-28201



# डा० भीमराव आंबेडकर विश्वविद्यालय, आगरा

(पूर्ववर्ती: आगरा विश्वविद्यालय, आगरा)

संख्या:शैक्षिक/67/2022  
दिनांक: 02/09/2022

## अधिसूचना

एतद् द्वारा सूचित किया जाता है कि कार्य परिषद् की बैठक दिनांक 15.03.2022 एवं शासनादेश संख्या: 401/सत्तर-3-2022 दिनांक 09 फरवरी, 2022 के अनुपालन में विश्वविद्यालय से सम्बद्ध समस्त राजकीय/अनुदानित अशासकीय/स्ववित्तपोषित महाविद्यालयों में सत्र 2022-23 से एम0ए0, एम0कॉम0 एवं एम0एस0सी0 में प्रवेश राष्ट्रीय शिक्षा नीति-2020 के अर्न्तगत (सप्तम सेमेस्टर में) संलग्न प्रवेश सम्बन्धी नियमावली तथा अन्य सम्बन्धित दिशा निर्देशों के अनुसार किये जायेंगे। भविष्य में जारी शासकीय निर्देशों के अनुक्रम में इस नियमावली व निर्देशों का संशोधित संस्करण या अलग से कोई अन्य अधिसूचना जारी की जायेगी।

संलग्नक:- यथोपरि।

संख्या:शैक्षिक/3010/22  
दिनांक: 02/09/2022

  
कुलसचिव

प्रतिलिपि:- निम्नलिखित को सूचनार्थ एवं आवश्यक कार्यवाही हेतु प्रेषित।

1. प्राचार्य/प्राचार्या, सम्बद्ध समस्त राजकीय/अनुदानित अशासकीय/स्ववित्तपोषित महाविद्यालय।
2. वित्त अधिकारी।
3. परीक्षा नियंत्रक।
4. सहायक कुलसचिव, कुलपति सचिवालय डा0 भीमराव आंबेडकर विश्वविद्यालय, आगरा, माननीय कुलपति जी के अवलोकनार्थ।
5. सहायक कुलसचिव(गोपनीय विभाग/परीक्षा विभाग/प्रशासन)
6. अधीक्षक कुलसचिव, कुलसचिव जी के सूचनार्थ।
7. प्रभारी वेबसाइट को इस आशय से प्रेषित कि उक्त सूचना समस्त महाविद्यालयों के कॉलेज लॉगिन पर अपलोड कराना सुनिश्चित करें।

  
कुलसचिव

## डा० भीमराव आंबेडकर विश्वविद्यालय, आगरा

उत्तर प्रदेश के समस्त विश्वविद्यालयों एवं महाविद्यालयों में राष्ट्रीय शिक्षा नीति-2020 लागू किये जाने हेतु उच्च शिक्षा विभाग उत्तर प्रदेश शासन ने शासनादेश, संख्या-1567/सत्तर-3-2021-16(26)/2011 टी०सी०, दिनांक 13 जुलाई 2021 जारी किया था जिसके बिन्दु संख्या - 4 में कहा गया था कि परास्नातक एवं पी०एच०डी० पाठ्यक्रमों/कार्यक्रमों में सी०बी०सी०एस० आधारित नवीन पाठ्यक्रम शैक्षणिक सत्र 2022-23 से लागू होगा। वर्तमान स्थिति में यह व्यवस्था M.A., M.Sc., व M.Com. में लागू की जायेगी। अन्य विषय/पाठ्यक्रम जिसमें किसी नियामक संस्था के नियम लागू होते हैं, उनकी व्यवस्था का निर्धारण नियामक संस्थाओं के अनुरूप नये पाठ्यक्रम व संरचना के आने पर किया जायेगा।

उपरोक्त शासनादेश एवं शासनादेश संख्या : 401/सत्तर-3-2022 दिनांक : 09- फरवरी-2022 के अनुक्रम में डा० भीमराव आंबेडकर विश्वविद्यालय, आगरा में राष्ट्रीय शिक्षा नीति-2020 को स्नातक (शोध सहित), परास्नातक एवं पी०एच०डी० स्तर पर लागू किये जाने हेतु निम्नलिखित नियमावली तैयार की जाती है।

### संकाय

1. संकाय विषयों का समूह है, यथा कला संकाय, विज्ञान संकाय, वाणिज्य संकाय इत्यादि।
2. विश्वविद्यालय में जो संकाय एवं प्रशासनिक व्यवस्था चल रही है वह यथावत् रहेगी।

### स्नातकोत्तर में प्रवेश व निकास-

1. नवीन अथवा पुरातन प्रणाली के तीन वर्षीय स्नातक उपाधि प्राप्त विद्यार्थी, स्नातकोत्तर कार्यक्रम के प्रथम वर्ष में प्रवेश लेंगे। यह वर्ष उच्च शिक्षा का चतुर्थ वर्ष कहलायेगा।
2. इस वर्ष में प्रवेश विश्वविद्यालय के नियमानुसार प्रवेश परीक्षा अथवा मेरिट पर आधारित होगा।
3. प्रवेश के लिये न्यूनतम अर्हता विश्वविद्यालय के नियमानुसार ही रहेगी।
4. स्नातकोत्तर के प्रथम वर्ष में न्यूनतम 52 क्रेडिट अर्जित कर उत्तीर्ण करने के पश्चात् यदि कोई छात्र छोड़ कर जाना चाहता है, तो उसे स्नातक(शोध सहित) की उपाधि दी जायेगी। स्नातकोत्तर प्रथम व द्वितीय वर्ष दोनों में न्यूनतम  $52+48=100$  क्रेडिट अर्जित करके, उत्तीर्ण करने पर छात्र को उस संकाय के उस मुख्य विषय में स्नातकोत्तर की उपाधि प्रदान की जायेगी।
5. प्रवेश, निकास एवं पुनः प्रवेश व्यवस्था के सम्बन्ध में गाइडलाइन विश्वविद्यालय द्वारा ही जारी की जायेगी, महाविद्यालय अपने स्तर से इस सम्बन्ध में निर्णय नहीं लेंगे।

### प्रवेश प्रक्रिया एवं विशय चयन व्यवस्था:

1. विद्यार्थी परास्नातक में प्रवेश के लिए विश्वविद्यालय की वेब साइट पर अपना रजिस्ट्रेशन कराएँगे तथा डब्ल्यू०आर०एन० नम्बर अंकित किये हुए रजिस्ट्रेशन के प्रपत्र को विश्वविद्यालय के संस्थान/विभाग/महाविद्यालयों में जमा कर मेरिट अथवा अन्य प्रवेश नियमों, सम्बंधित महाविद्यालय में उपलब्ध अनुमोदित सीटों तथा संसाधनों के आधार पर प्रवेश ले सकेंगे।
2. प्रवेश हेतु अतिरिक्त अंको की व्यवस्था विश्वविद्यालय की प्रवेश समिति की बैठक दिनांक 02.06.2022 में लिये गये निर्णय के अनुसार होगी।

### मेजर विशयों का चुनाव

1. विद्यार्थी को परास्नातक में प्रवेश के समय सर्वप्रथम विश्वविद्यालय/महाविद्यालय में एक संकाय (कला, विज्ञान, वाणिज्य आदि) का चुनाव करना होगा और तत्पश्चात् उसे उस संकाय के किसी एक मुख्य (मेजर) विषय का चुनाव करना होगा जिसका आवंटन महाविद्यालय में मेरिट, उपलब्ध सीट की संख्या व संसाधनों पर निर्भर करेगा। यह संकाय विद्यार्थी का अपना संकाय (Own Faculty) कहलायेगा, जिसमें वह चतुर्थ वर्ष (सातवां व आठवां सेमेस्टर) तथा पाँचवें वर्ष (नवां व दसवां सेमेस्टर) अध्ययन कर सकेगा।
2. इसके उपरान्त विद्यार्थी एक और माइनर इलेक्टिव पेपर का चुनाव करेगा जो दूसरे संकाय (Other Faculty) से होगा।

## माइनर इलेक्टिव पेपर का चुनाव

1. मुख्य विषय के अतिरिक्त विद्यार्थी को एक माइनर इलेक्टिव पेपर का अध्ययन करना होगा। दूसरे संकाय के विषय में से कर सकते हैं। इसके लिये किसी पूर्व पात्रता (pre-requisite) की आवश्यकता नहीं होगी।
2. कोई विद्यार्थी एक माइनर इलेक्टिव पेपर परास्नातक प्रथम वर्ष के प्रथम अथवा द्वितीय सेमेस्टर में अन्य संकाय के उपलब्ध माइनर इलेक्टिव पेपर का चुनाव कर सकता है।
3. विश्वविद्यालय/महाविद्यालय द्वारा उपलब्ध सीटों के आधार पर माइनर/इलेक्टिव विषय आवंटित किया जायेगा।

## क्रेडिट एवं क्रेडिट निर्धारण:

1. क्रेडिट के आधार पर शिक्षण कार्य थ्योरी के एक क्रेडिट के पेपर में एक घंटा प्रति सप्ताह का शिक्षण कार्य होगा, एक सेमेस्टर के 15 सप्ताह में 15 घंटे का शिक्षण कराना होगा।
2. प्रैक्टिकल/इंटर्नशिप/फील्ड वर्क आदि के एक क्रेडिट के पेपर में दो घंटे प्रति सप्ताह का शिक्षण कार्य होगा, अर्थात् एक सेमेस्टर के 15 सप्ताह में 30 घंटे का प्रैक्टिकल/इंटर्नशिप/फील्ड वर्क आदि कराना होगा। शिक्षक के कार्यभार की गणना में थ्योरी के एक घंटे का कार्यभार प्रैक्टिकल/इंटर्नशिप/फील्ड वर्क आदि के दो घंटे के कार्यभार के बराबर होगा।
3. क्रेडिट एवं क्रेडिट निर्धारण तथा उपस्थिति आदि के नियम उपरोक्त उल्लेखित 13 जुलाई 2021 के शासनादेश के बिन्दु संख्या 9 व 10 में दिये गये हैं।

## उपस्थिति व क्रेडिट निर्धारण:

1. क्रेडिट वैलिडेशन के लिए परीक्षा देना आवश्यक होगा। परीक्षा के बिना क्रेडिट अपूर्ण होंगे।
2. परीक्षा देने के लिए पूर्व नियमानुसार 75 प्रतिशत उपस्थिति अनिवार्य होगी।
3. छात्र कक्षा में उपस्थिति के आधार पर परीक्षा के लिए अर्हता प्राप्त करता है, परन्तु किसी कारण से नहीं दे पाता, तो आगामी समय में परीक्षा दे सकता है।

## राष्ट्रीय प्रीक्षा नीति-2020 के सन्दर्भ में विद्यार्थी को प्राप्त होने वाली अन्य सुविधाएँ:

1. ऑनलाइन कार्स के क्रेडिट को जोड़ने की व्यवस्था :- विद्यार्थी मान्यता प्राप्त संस्थानों (UGC, SWAYAM, MOOCs portals) से 20 प्रतिशत तक या यू0जी0सी0/शिक्षा मंत्रालय, भारत सरकार द्वारा अनुमन्य सीमा तक क्रेडिट ऑनलाइन कार्स के माध्यम से प्राप्त कर सकेंगे तथा उसके अनुपालन में कोर्स/विषय छोड़ सकेंगे। विश्वविद्यालय व्यवस्था के दृष्टिगत ऑनलाइन पेपर चयनित किये जाने की यह सुविधा माइनर/इलेक्टिव पेपर्स के लिए छूट पर ही लागू होगी। यू0जी0सी0 के नियमों के अनुसार ऑनलाइन कोर्स के क्रेडिट सभी विश्वविद्यालय/महाविद्यालयों को जोड़ने होंगे।
2. माइनर इलेक्टिव विशेष विषय को अन्य शिक्षण संस्थानों से पढ़ने की सुविधा:- विद्यार्थी की आवश्यकता के अनुसार यदि माइनर इलेक्टिव उपलब्ध नहीं है तब, निकट के शिक्षण संस्थान से किसी माइनर इलेक्टिव के अध्ययन की विश्वविद्यालय द्वारा अनुमन्य की जा सकती है। इस सुविधा का लाभ विद्यार्थियों को प्रदान करने के लिए सम्बन्धित महाविद्यालय से पारम्परिक रूप से अनुबन्ध हस्ताक्षरित करते हुए उसका अनुमोदन विश्वविद्यालय से कराया जायेगा।

## स्नातकोत्तर व पी0एच0डी0आर0 पाठ्यक्रम/कार्यक्रम संरचना-

1. स्नातकोत्तर प्रथम वर्ष तक (132 + 52) संचित क्रेडिट के सापेक्ष इस वर्ष में एक प्रमुख विषय, एक माइनर विषय तथा दो प्रमुख वृहद शोध परियोजनाएँ सम्मिलित होंगी। जिसे उत्तीर्ण करने पर शोध सहित स्नातक Bachelor (Research) in Faculty की उपाधि प्रदान की जायेगी।
2. स्नातकोत्तर द्वितीय वर्ष तक (132 + 52 + 48) संचित क्रेडिट के सापेक्ष इस वर्ष में एक प्रमुख विषय एवं दो प्रमुख अनुसंधान परियोजनाएँ सम्मिलित होंगी, जिसे उत्तीर्ण करने के उपरान्त स्नातकोत्तर Master in Faculty उपाधि प्रदान की जायेगी।

नोट :- पुरानी पद्धति से उत्तीर्ण कर आने वाले छात्रों के लिये 132 क्रेडिट की अनिवार्यता न होकर, पुरानी पद्धति की योग्यता मान्य रहेगी, अतः पुरानी पद्धति से आये हुये छात्रों के लिये परास्नातक प्रथम वर्ष में 52 क्रेडिट व द्वितीय वर्ष में 48 कुल, (52+48=100) क्रेडिट के सापेक्ष उपाधि प्रदान की जायेगी।

3. स्नातकोत्तर द्वितीय वर्ष के उपरान्त विद्यार्थी छः मास का स्नातकोत्तर डिप्लोमा (शोध) (P.G.D.R. - Post Graduate Diploma in Research) प्रवेश ले सकता है जोकि 16 क्रेडिट (कुल संचित क्रेडिट 248) का



- होगा। इस डिप्लोमा में एक विषय में दो पेपर, एक अनुसंधान पद्धति एवं एक प्रमुख अनुसंधान परियोजना जोकि किसी Affiliated Guide के निर्देशन में तैयार की जायेगी सम्मिलित होगी।
4. पी0एच0डी0आर0 को उत्तीर्ण करने की व्यवस्था ठीक वही रहेगी जोकि परास्नातक के लिये है।
  5. पी0एच0डी0आर0 की अनुसंधान परियोजना को BOS से पास कराया जायेगा और 16 क्रेडिट अर्जित करने और अनुसंधान परियोजना को पूर्ण करने के उपरान्त ही पी0एच0डी0आर0 की उपाधि प्रदान की जायेगी।
  6. पी0एच0डी0आर0 में प्रवेश विश्वविद्यालय द्वारा प्रवेश परीक्षा के माध्यम से किया जायेगा और उसमें न्यूनतम 50% अंक आना अनिवार्य रहेगा।
  7. पी0एच0डी0आर0 की Fees रु 25000/- + Exam Fee रहेगी और सीटों की संख्या विषय के अनुसार प्रथक - प्रथक हो सकती है।
  8. पी0एच0डी0आर0 पाठ्यक्रम विश्वविद्यालय के आवासीय संस्थानों/विभागों में है।
  9. प्राथमिकता के आधार पर सातवें और आठवें वर्ष में (अन्यथा की स्थिति में उसके आगे के वर्षों में) शोध-प्रबन्ध (Research Thesis) जमा कराना होगा, जिसके मूल्यांकन के उपरान्त सफल घोषित किये जाने की संस्तुति के आधार पर पी-एच.डी. की उपाधि प्रदान की जायेगी। पी0एच0डी0 के लिये UGC के अनुसार ही गाइड लाइन पृथकरण से तैयार की जायेगी।
  10. यूजीफार्म क्रेडिट एवं ग्रेडिंग सिस्टम का निर्धारण शासकीय निर्देशों के अनुरूप प्रचलित व्यवस्था के मानकानुरूप किया जायेगा।
  11. स्नातकोत्तर पी0एच0डी0आर0 कार्यक्रम की संरचना जैसे कि पेपर्स का प्रकार, उनकी संख्या व क्रेडिट इत्यादि, (जुलाई 2021 के शासनदेश के अनुसार) संलग्न तालिका में दी हुई है। सुलभ संदर्भ के लिए यह तालिका इस पत्र के अंत में अंकित है।
  12. स्नातकोत्तर पी0एच0डी0आर0 में एक ही मुख्य विषय (Major Subject) होगा।
  13. स्नातकोत्तर पी0एच0डी0आर0 कार्यक्रम सी0बी0सी0एस0 एवं सेमेस्टर प्रणाली में संचालित होगा।
  14. स्नातकोत्तर के मुख्य विषय के चार थ्योरी के पेपर (पाँच क्रेडिट का एक) अथवा चार थ्योरी के व एक प्रयोगात्मक पेपर (सभी चार चार क्रेडिट) एक सेमेस्टर में होंगे। इस प्रकार एक सेमेस्टर में मुख्य विषय के पेपर्स के 20 क्रेडिट होंगे। एक वर्ष में 40 व दो वर्ष में 80 क्रेडिट होंगे।
  15. स्नातकोत्तर कार्यक्रम का पाठ्यक्रम इस प्रकार बनाया जायेगा कि उसमें अधिकाधिक Optional पेपर्स हों। जैसे कि प्रथम व द्वितीय सेमेस्टर में चारों थ्योरी पेपर्स अनिवार्य हो सकते हैं। तृतीय सेमेस्टर में एक अथवा दो पेपर Specialization पर आधारित optional पेपर्स में से विद्यार्थी अपनी रुचि के अनुसार एवं विश्वविद्यालय/महाविद्यालय में उपलब्ध संसाधनों के आधार पर पेपर्स का चुनाव कर सकता है। चतुर्थ सेमेस्टर में अधिकाधिक अथवा सभी पेपर्स Specialization पर आधारित optional पेपर्स हो सकते हैं।
  16. स्नातकोत्तर प्रथम वर्ष में छात्र को केवल एक माइजर इलेक्टिव पेपर मुख्य विषय से अलग किसी अन्य संकाय के विषय का लेना होगा। यह पेपर 4 या अधिक क्रेडिट का होगा।
  17. उपरोक्त सभी पेपर्स के पाठ्यक्रम (Syllabus) डा0 भीमराव आंबेडकर विश्वविद्यालय आगरा द्वारा अपनी पाठ्यक्रम समिति (Board of Studies) एवं विद्वत परिषद (Academic Council) से अनुमोदित कराये जायेंगे।

#### स्नातकोत्तर कार्यक्रम में शोध परियोजना (Research Project)-

1. उच्च शिक्षा के चतुर्थ एवं पंचम वर्ष (स्नातकोत्तर के प्रथम एवं द्वितीय वर्ष) में विद्यार्थी को वृहद शोध परियोजना करनी होगी।
2. विद्यार्थी को चतुर्थ एवं पंचम वर्ष में उसके द्वारा चुने गये मुख्य विषय से सम्बंधित शोध परियोजना करनी होगी।
3. यह शोध परियोजना interdisciplinary/multi-disciplinary भी हो सकती है। यह शोध परियोजना इन्डस्ट्रियल ट्रेनिंग/इन्टरनशिप/सर्वे वर्क इत्यादि के रूप में भी हो सकती है।
4. शोध परियोजना एक शिक्षक सुपरवाइजर के निर्देशन में की जायेगी, एक अन्य को-सुपरवाइजर किसी उद्योग/कम्पनी/तकनीकी संस्थान/शोध संस्थान से लिया जा सकता है।
5. स्नातक(शोध सहित) एवं स्नातकोत्तर के विद्यार्थी को प्रत्येक सेमेस्टर में चार क्रेडिट (चार घंटे प्रति सप्ताह) की शोध परियोजना करनी होगी।
6. विद्यार्थी वर्ष के अंत में दोनों सेमेस्टर में की गई शोध परियोजना का संयुक्त प्रबंध (Project Report/Dissertation) जमा करेगा (Plagiarism Certificate के साथ) जिसका मूल्यांकन वर्ष के अंत में सुपरवाइजर एवं विश्वविद्यालय द्वारा नामित वाह्य परीक्षक द्वारा संयुक्त रूप से 100 अंकों में से किया जायेगा। इस प्रकार इस परीक्षा के कुल 8 क्रेडिट होंगे।
7. यदि कोई विद्यार्थी अपनी इस शोध परियोजना में से कोई शोध पत्र UGC-CARE Listed जर्नल में स्नातकोत्तर कार्यक्रम के दौरान प्रकाशित करवाता है, तो उसे शोध परियोजना के मूल्यांकन (पूर्णांक 100 में से) में 25 अंक तक अतिरिक्त अंक दिये जा सकते हैं। प्राप्तांक अधिकतम 100 ही होंगे।

8. शोध परियोजना के प्राप्तांको पर आधारित ग्रेड अंकित होंगे तथा उन्हें सी0जी0पी0ए0 की गणना में भी सम्मिलित किया जायेगा।

**स्नातकोत्तर व पी0एच0डी0आर0 पाठ्यक्रम परीक्षा व्यवस्था:-**

1. सभी विषयों के प्रश्नपत्र (Theory and Practical) 100 (75 बाह्य + 25 आंतरिक) अंको के होंगे, जिनको क्रेडिट एवं फार्मूला के अनुसार परसेंटाइल एवं ग्रेड में सॉफ्टवेयर द्वारा परिवर्तित कर दिया जायेगा।
2. 25 अंको का आन्तरिक मूल्यांकन पाठ्यक्रमों में वर्णित व्यवस्था अथवा निम्न व्यवस्था के अनुसार होगा।

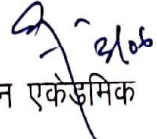
क्रम संख्या	मूल्यांकन विधि	अधिकतम अंक
1.	Assignment/field work/Seminar	10
2.	Class Test/Quiz	5 X 2 =10
3.	Class Interaction (Attendance etc.)	5
योग :-	--	25

3. महाविद्यालय केन्द्रीकृत व्यवस्था या अन्य सुचितापूर्ण व्यवस्था के अनुरूप सतत आन्तरिक मूल्यांकन करायेंगे तथा असाइनमेंट, क्लास टेस्ट की उत्तरपुस्तिकाओं व अन्य रिपोर्टों को परीक्षा परिणाम घोषित होने के कम से कम एक वर्ष आगे तक सुरक्षित रखा जायेगा।
4. पी0एच0डी0आर0 पाठ्यक्रम वर्तमान में सिर्फ विश्वविद्यालय की आवासीय इकाई में ही संचालित किये जायेंगे।
5. विश्वविद्यालय की आवासीय इकाई के लिये प्रवेश, परीक्षा, अथादमिक व लेन्डर इत्यादि, महाविद्यालयों से प्रथक रहेगा।
6. छात्र के बाह्य (75%) एवं आंतरिक (25%) परीक्षा दोनों में पृथक - पृथक रूप से 40 अंक (30 व 10) अंक आना अनिवार्य है।

व्यलपति जी  
Patupin Aca

सा  
27/06/22

1. वह विद्यार्थी जो कि NEP-2020 के तहत परास्नातक पाठ्यक्रम में प्रवेश ले रहे हैं और पुरानी शिक्षा पद्धति से उत्तीर्ण हैं, उनको परास्नातक पाठ्यक्रम दो वर्ष का करना होगा और उन छात्रों को एक वर्ष के बाद स्नातक (शोध सहित) उपाधि प्रदान नहीं की जायेगी। स्नातक (शोध) की उपाधि सिर्फ NEP-2020 से उत्तीर्ण (तीन वर्ष पूर्ण करने के उपरान्त) छात्रों को ही प्रदान की जायेगी।
2. परास्नातक पाठ्यक्रम में प्रवेश की योग्यता वही रहेगी जो कि वर्तमान में प्रचलित है। प्रवेश की योग्यता में परिवर्तन NEP-2020 के प्रथम बैठ के उत्तीर्ण होने के बाद ही होगा।  
यह व्यवस्था (स्नातक/शोध व योग्यता में परिवर्तन) सत्र 2024-25 से लागू होगी।
3. PGDGR में प्रवेश की योग्यता "परास्नातक (उस विषय में) 55 % अंकों के साथ उत्तीर्ण" रहेगी।

  
डीन एकेडमिक

  
प्रति कुलपति

438  
06/06/22

14. स्नातक व स्नातकोत्तर कार्यक्रमों की वर्षवार संरचना

Year	Sem.	Subject I	Subject II	Subject III	Subject IV	Vocational	Co-Curricular	Industrial Training/ Survey/ Research Project	{Minimum Credits} For the year	{Cumulative Minimum Credits} Required for Award of Certificate/ Diploma/ Degree
		Major 4/5/6 Credits	Major 4/5/6 Credits	Major 4/5/6 Credits	Minor Elective 4/5/6 Credits	Minor 3 Credits	Minor	Major 4 Credits		
Year	Sem.	Own Faculty	Own Faculty	Own/ Other Faculty	Other Subject/ Faculty	Vocational/ Skill Development Course	Co-Curricular Course (Qualifying)	Inter/Intra Faculty related to main Subject		
1	I	Th-1(6) or Th-1(4)+ Pract-1(2)	Th-1(6) or Th-1(4)+ Pract-1(2)	Th-1(6) or Th-1(4)+ Pract-1(2)	1 (4/5/6)	1	1		46	{46} Certificate in Faculty
	II	Th-1(6) or Th-1(4)+ Pract-1(2)	Th-1(6) or Th-1(4)+ Pract-1(2)	Th-1(6) or Th-1(4)+ Pract-1(2)		1	1			
2	III	Th-1(6) or Th-1(4)+ Pract-1(2)	Th-1(6) or Th-1(4)+ Pract-1(2)	Th-1(6) or Th-1(4)+ Pract-1(2)	1 (4/5/6)	1	1		46	{92} Diploma in Faculty
	IV	Th-1(6) or Th-1(4)+ Pract-1(2)	Th-1(6) or Th-1(4)+ Pract-1(2)	Th-1(6) or Th-1(4)+ Pract-1(2)		1	1			
3	V	Th-2(5) or Th-2(4)+ Pract-1(2)	Th-2(5) or Th-2(4)+ Pract-1(2)				1	1 (Qualifying)	40	{132} Bachelor in Faculty
	VI	Th-2(5) or Th-2(4)+ Pract-1(2)	Th-2(5) or Th-2(4)+ Pract-1(2)				1	1 (Qualifying)		
4	VII	Th-4(5) or Th-4(4)+ Pract-1(4)			1 (4/5/6)			1 (4)	52	{184} Bachelor (Research) in Faculty
	VIII	Th-4(5) or Th-4(4)+ Pract-1(4)						1 (4)		
5	IX	Th-4(5) or Th-4(4)+ Pract-1(4)						1 (4)	48	{232} Master in Faculty
	X	Th-4(5) or Th-4(4)+ Pract-1(4)						1 (4)		
6	XI	2 (6)	1 Research (4) Methodology					1 (Qualifying)	16	{248} PGDR in Subject
6,7,8	XII-XVI							Ph. D. Thesis		Ph. D. in Subject

Note: Blue Colour: No. of papers Red colour: Credits Purple colour: Non-Credit Qualifying Courses; Th-Theory, Pract-Practical



fw wh  
Dean Academic  
10.2.2022

उत्तर प्रदेश शासन  
उच्च शिक्षा अनुभाग-3  
संख्या-4.01/सत्तर-3-2022  
लखनऊ : दिनांक: 07 फरवरी, 2022

- 1- कुलपति,  
समस्त राज्य/निजी विश्वविद्यालय,  
उत्तर प्रदेश।
- 2- निदेशक,  
उच्च शिक्षा, उ०प्र०  
प्रयागराज।

प्रदेश के समस्त विश्वविद्यालयों एवं महाविद्यालयों में राष्ट्रीय शिक्षा नीति-2020 लागू किए जाने विषयक शासनादेश संख्या-1567/सत्तर-3-2021-16(26)/2011 टी.सी., दिनांक 13.07.2021 का कृपया सन्दर्भ ग्रहण करे जिसमें उल्लेख किया गया था कि सी.बी.सी.एस. आधारित नवीन पाठ्यक्रम स्नातक स्तर पर शैक्षिक सत्र 2021-22 तथा उच्चतर स्तरों पर शैक्षिक सत्र 2022-23 से लागू होगा। प्रदेश के सभी उच्च शिक्षण संस्थानों में स्नातक स्तर पर राष्ट्रीय शिक्षा नीति-2020 के अनुरूप पाठ्यक्रम 2021-22 में लागू कर दिए गए हैं।

2- पाठ्यक्रम पुनर्संरचना की राज्य स्तरीय समिति द्वारा प्रदेश के समस्त विश्वविद्यालयों एवं महाविद्यालयों में राष्ट्रीय शिक्षा नीति-2020 को स्नातक (शोध सहित), स्नातकोत्तर एवं पी०एच०डी० स्तर पर लागू किये जाने हेतु सुझाव दिये गये हैं, जिन्हे संलग्न कर प्रेषित किया जा रहा है। विश्वविद्यालय कृपया इन पर विचार करना चाहें तथा स्नातकोत्तर पाठ्यक्रमों की पुनर्संरचना करके एवं सक्षम प्राधिकारी का अनुमोदन प्राप्त करके शैक्षिक सत्र 2022-23 से लागू करना सुनिश्चित करें।  
संलग्नक यथोक्त।

भवदीया,

( मोनिका एस. गर्ग )  
अपर मुख्य सचिव।

संख्या-4.01/सत्तर-3-2022-तददिनांक:

प्रतिलिपि निम्नलिखित को सूचनार्थ एवं आवश्यक कार्यवाही हेतु प्रेषित:-

- 1- कुलसचिव, समस्त राज्य/निजी विश्वविद्यालय, उ०प्र०।
- 2- समस्त क्षेत्रीय उच्च शिक्षा अधिकारी उ०प्र०।
- 3- प्रो० हरे कृष्ण, सांख्यिकी विभाग, चौधरी चरण सिंह विश्वविद्यालय, मेरठ, उ०प्र०।
- 4- डॉ० दिनेश चन्द्र शर्मा, जन्तु विज्ञान विभाग, कु०मा० कन्या पी०जी० राजकीय महाविद्यालय, बादलपुर, उ०प्र०।

आज्ञा से,

( शमीम अहमद खान )  
सचिव।

## संलग्नक

### उत्तर प्रदेश के समस्त विश्वविद्यालयों एवं महाविद्यालयों में राष्ट्रीय शिक्षा नीति-2020 को स्नातक (शोध सहित), स्नातकोत्तर एवं पी0एच0डी0 स्तर पर लागू किये जाने हेतु सुझाव

उत्तर प्रदेश के समस्त विश्वविद्यालयों एवं महाविद्यालयों में राष्ट्रीय शिक्षा नीति-2020 लागू किये जाने हेतु उच्च शिक्षा विभाग उत्तर प्रदेश शासन ने शासनादेश, संख्या-1567/सत्तर-3-2021-16(26)/2011 टी0सी0, दिनांक 13 जुलाई 2021 जारी किया था जिसके बिन्दु संख्या-4 में कहा गया था कि स्नातक (शोध सहित), स्नातकोत्तर एवं पी0एच0डी0 पाठ्यक्रमों/कार्यक्रमों में सी0बी0सी0एस0 आधारित नवीन पाठ्यक्रम शैक्षणिक रात्र 2022-23 से लागू होगा।

इस सम्बन्ध में निम्न सुझाव/योजना प्रस्तुत है :-

#### क्षेत्र (Scope)-

- जिन संकायों के पाठ्यक्रमों/कार्यक्रमों में किसी नियामक संस्था के नियम लागू नहीं होते जैसे कि एम0ए0, एम0एस0सी0 एवं एम0काम0 इत्यादि, उनमें यह व्यवस्था लागू होगी।
- चिकित्सा (Medicine and Dental etc.), तकनीकी शिक्षा (B.Tech, MCA etc.), विधि (बी0ए0-एल0एल0बी0, बी0एस0सी-एल0एल0बी0, एल0एल0बी0, एल0एल0एम0, इत्यादि), शिक्षक शिक्षा (बी.एड., एम.एड., बी.पी.एड., एम.पी.एड.) इत्यादि के लिये व्यवस्था का निर्धारण उनकी नियामक संस्थाओं के एनईपी-2020 के अनुरूप नए पाठ्यक्रम व संरचना के आने पर किया जायेगा।

#### स्नातकोत्तर में प्रवेश व निकास-

- नवीन अथवा पुरातन प्रणाली के तीन वर्षीय स्नातक उपाधि प्राप्त विद्यार्थी स्नातकोत्तर कार्यक्रम के प्रथम वर्ष में प्रवेश लेंगे। यह वर्ष उच्च शिक्षा का चतुर्थ वर्ष कहलायेगा।
- इस वर्ष में प्रवेश विश्वविद्यालय के नियमानुसार प्रवेश परीक्षा अथवा मेरिट पर आधारित होगा।
- प्रवेश के लिए न्यूनतम अर्हता विश्वविद्यालय के नियमानुसार होगी।
- स्नातकोत्तर के प्रथम वर्ष में न्यूनतम 52 क्रेडिट अर्जित कर उत्तीर्ण करने के पश्चात यदि कोई छात्र छोड़ कर जाना चाहता है तो उसे स्नातक (शोध सहित) की उपाधि दी जायेगी। स्नातकोत्तर प्रथम व द्वितीय वर्ष दोनों में न्यूनतम 52+48 क्रेडिट अर्जित करके उत्तीर्ण करने पर छात्र को उस संकाय के उस मुख्य विषय में स्नातकोत्तर की उपाधि प्रदान की जायेगी।

#### स्नातकोत्तर पाठ्यक्रम/कार्यक्रम संरचना-

- स्नातकोत्तर कार्यक्रम की संरचना जैसे कि पेपर्स का प्रकार, उनकी संख्या व क्रेडिट इत्यादि, उपरोक्त उल्लेखित 13 जुलाई 2021 के शासनादेश के अंतिम पृष्ठ पर एक तालिका में दी हुई है। सुलभ संदर्भ के लिए यह तालिका इस पत्र के अंत में भी अंकित है।
- स्नातकोत्तर में एक ही मुख्य विषय (Major Subject) होगा।

- स्नातकोत्तर कार्यक्रम सी0बी0सी0एस0 एवं सेमेस्टर प्रणाली में संचालित होगा।
- मुख्य विषय के चार थ्योरी के पेपर (पाँच क्रेडिट का एक) अथवा चार थ्योरी के व एक प्रयोगात्मक पेपर (सभी चार चार क्रेडिट) एक सेमेस्टर में होंगे। इस प्रकार एक सेमेस्टर में मुख्य विषय के पेपर्स के 20 क्रेडिट होंगे। एक वर्ष में 40 व दो वर्ष में 80 क्रेडिट होंगे।
- स्नातकोत्तर कार्यक्रम का पाठ्यक्रम इस प्रकार बनाया जायेगा कि उसमें अधिकाधिक **Optional** पेपर्स हों।  
जैसे कि प्रथम सेमेस्टर में चारों थ्योरी पेपर्स अनिवार्य हो सकते हैं। द्वितीय व तृतीय सेमेस्टर में एक अथवा दो पेपर **specialization** पर आधारित **optional** पेपर्स में से विद्यार्थी अपनी रुचि के अनुसार एवं विश्वविद्यालय/महाविद्यालय में उपलब्ध संसाधनों के आधार पर इन पेपर्स का चुनाव कर सकता है। चतुर्थ सेमेस्टर में अधिकाधिक अथवा सभी पेपर्स **specialization** पर आधारित **optional** पेपर्स होना समुचित रहेगा।
- स्नातकोत्तर प्रथम वर्ष में छात्र को केवल एक **माइनर इलेक्टिव पेपर**, मुख्य विषय से अलग किसी अन्य संकाय के विषय का लेना होगा। यह पेपर 4 या अधिक क्रेडिट का होगा।
- उपरोक्त सभी पेपर्स के पाठ्यक्रम (Syllabus) विश्वविद्यालय द्वारा अपनी पाठ्यक्रम समिति (Board of Studies) एवं विद्वत परिषद (Academic Council) से शीघ्र ही अनुमोदित कराये जायेंगे।

#### स्नातकोत्तर कार्यक्रम में शोध परियोजना (Research Project)

- उच्च शिक्षा के चतुर्थ एवं पंचम वर्ष (स्नातकोत्तर के प्रथम एवं द्वितीय वर्ष) में विद्यार्थी को वृहद शोध परियोजना करनी होगी।
- विद्यार्थी को चतुर्थ एवं पंचम वर्ष में उसके द्वारा चुने गये मुख्य विषय से सम्बंधित शोध परियोजना करनी होगी।
- यह शोध परियोजना **interdisciplinary/ multi-disciplinary** भी हो सकती है। यह शोध परियोजना **इन्डस्ट्रियल ट्रेनिंग/इन्टरनशिप/सर्व वर्क** इत्यादि के रूप में भी हो सकती है।
- शोध परियोजना एक शिक्षक सुपरवाइजर के निर्देशन में की जायेगी, एक अन्य को—सुपरवाइजर किसी उद्योग/कम्पनी/तकनीकी संस्थान/शोध संस्थान से लिया जा सकता है।
- स्नातक (शोध सहित) एवं स्नातकोत्तर के विद्यार्थी को प्रत्येक सेमेस्टर में चार क्रेडिट (चार घंटे प्रति सप्ताह) की शोध परियोजना करनी होगी।
- विद्यार्थी वर्ष के अंत में दोनों सेमेस्टर में की गई शोध परियोजना का संयुक्त प्रबंध (Project Report/ Dissertation) जमा करेगा, जिसका मूल्यांकन वर्ष के अंत में सुपरवाइजर एवं विश्वविद्यालय द्वारा नामित वाह्य परीक्षक द्वारा संयुक्त रूप से **100 अंकों** में से किया जायेगा। इस प्रकार इस परीक्षा के कुल 8 क्रेडिट होंगे।
- यदि कोई विद्यार्थी अपनी इस शोध परियोजना में से कोई शोध पत्र **UGC-CARE listed** जर्नल में स्नातकोत्तर कार्यक्रम के दौरान प्रकाशित करवाता है, तो उसे शोध परियोजना के मूल्यांकन (पूर्णांक 100 में से) में 25 अंक तक अतिरिक्त अंक दिये जा सकते हैं। प्राप्तांक अधिकतम 100 ही होंगे।
- शोध परियोजना के प्राप्तांकों पर आधारित ग्रेड अंकित होंगे तथा उन्हें सी0जी0पी0ए0 की गणना में भी सम्मिलित किया जायेगा।

## क्रेडिट एवं क्रेडिट निर्धारण

- क्रेडिट एवं क्रेडिट निर्धारण तथा उपस्थिति आदि के नियम उपरोक्त उल्लेखित 13 जुलाई 2021 के शासनादेश के बिन्दु संख्या 9 व 10 में दिये गये हैं।

## पी0एच0डी0 कार्यक्रम

- पी0एच0डी0 कार्यक्रम में प्रवेश एवं संचालन के नियम व अध्यादेश विश्वविद्यालय द्वारा यू0जी0सी0 के दिशा निर्देशों के अनुसार बनाये जाते हैं।
- इसमें शोध परियोजना से पहले प्री-पी0एच0डी0 कोर्स वर्क करना अनिवार्य होता है।
- सभी विश्वविद्यालयों में प्री-पी0एच0डी0 कोर्स की संरचना में एकरूपता लाने के लिए इस कोर्स वर्क में दो पेपर मुख्य विषय के 6-6 क्रेडिट के होंगे तथा एक पेपर 4 क्रेडिट का उस मुख्य विषय से सम्बन्धित Research Methodology (including research ethics, plagiarism and computer applications) का होगा।
- उपरोक्त 16 क्रेडिट के तीन पेपर्स के पाठ्यक्रम (Syllabus) विश्वविद्यालय अपनी पाठ्यक्रम समिति (Board of Studies) एवं विद्वत परिषद (Academic Council) से शीघ्र ही अनुमोदित कराये जायेंगे।
- विश्वविद्यालय अनुदान आयोग नियमावली-2016 (UGC Regulation 2016) के बिन्दु संख्या 7.8 के अनुरूप प्री-पी0एच0डी0 कोर्स वर्क के न्यूनतम उत्तीर्ण अंक (Minimum Passing marks) 55% अथवा समकक्ष ग्रेड/ CGPA होंगे।
- उपरोक्त थ्योरी पेपर्स के अतिरिक्त, प्री-पी0एच0डी0 कोर्स वर्क में एक शोध परियोजना भी होगी, जिसका स्वरूप विश्वविद्यालय की BOS व Academic Council निर्धारित करेगी।
- प्री-पी0एच0डी0 कोर्स वर्क के विद्यार्थी की ग्रेड शीट पर शोध परियोजना के प्राप्तांकों पर आधारित ग्रेड तो अंकित होंगे परन्तु उन्हें सी0जी0पी0ए0 की गणना में सम्मिलित नहीं किया जायेगा।
- प्री-पी0एच0डी0 कोर्स वर्क में 16 क्रेडिट अर्जित करके उत्तीर्ण करने वाले विद्यार्थी को उस मुख्य विषय में Post Graduate Diploma in Research (PGDR) दिया जायेगा।
- प्री-पी0एच0डी0 कोर्स वर्क उत्तीर्ण करने के पश्चात विद्यार्थी को पी0एच0डी0 में शोध के लिए पंजीकृत किया जायेगा।
- उत्तर प्रदेश शासन ने शासनादेश, संख्या-69/सत्तर-1-2022 दिनांक 06-01-2021 के अनुसार सेवारत शिक्षकों के लिये प्री.पी.एच.डी. कोर्स वर्क को पूर्ण करने हेतु भौतिक कक्षाओं के साथ-साथ आनलाईन प्रक्रिया को भी मान्यता प्रदान करने हेतु विश्वविद्यालयों से कार्यवही करने को कहा है। इस सम्बंध में विश्वविद्यालय सेवारत शिक्षकों के लिये आनलाईन कोर्स वर्क का प्रारूप व नियम बना सकते हैं।

Grading (A/B/C/D)

Synopsis for res. project

Tentative supervisor allot to student as per area of interest.

online classes also to be ado. accepted & adapted

**Table - Year-wise Structure of UG/PG Programs**

Blue Colour: No. of papers

Red colour: Credits

Purple colour: Non-Credit Qualifying Courses

Year	Sem.	Subject I	Subject II	Subject III	Subject IV	Vocational	Co-Curricular	Industrial Training/ Survey / Research Project	{ Minimum Credits } For the year	{ Cumulative Minimum Credits } Required for Award of Certificate/ Diploma/ Degree
		Major 4/5/6 Credits	Major 4/5/6 Credits	Major 4/5/6 Credits	Minor Elective 4/5/6 Credits	Minor 3 Credits	Minor 2 Credits	Major 4 Credits		
		Own Faculty	Own Faculty	Own/ Other Faculty	Other Faculty	Vocational/ Skill Development Course	Co-Curricular Course (Qualifying)	Inter/Intra Faculty related to main Subject		
1	I	Th-1(6) or Th-1(4)+ Pract-1(2)	Th-1(6) or Th-1(4)+ Pract-1(2)	Th-1(6) or Th-1(4)+ Pract-1(2)	1 (4/5/6)	1	1		46	{46}  Certificate in Faculty
	II	Th-1(6) or Th-1(4)+ Pract-1(2)	Th-1(6) or Th-1(4)+ Pract-1(2)	Th-1(6) or Th-1(4)+ Pract-1(2)		1	1			
2	III	Th-1(6) or Th-1(4)+ Pract-1(2)	Th-1(6) or Th-1(4)+ Pract-1(2)	Th-1(6) or Th-1(4)+ Pract-1(2)	1 (4/5/6)	1	1		46	{92}  Diploma in Faculty
	IV	Th-1(6) or Th-1(4)+ Pract-1(2)	Th-1(6) or Th-1(4)+ Pract-1(2)	Th-1(6) or Th-1(4)+ Pract-1(2)		1	1			
3	V	Th-2(5) or Th-2(4)+ Pract-1(2)	Th-2(5) or Th-2(4)+ Pract-1(2)				1	1 (Qualifying)	40	{132}  Bachelor in Faculty
	VI	Th-2(5) or Th-2(4)+ Pract-1(2)	Th-2(5) or Th-2(4)+ Pract-1(2)				1	1 (Qualifying)		
4	VII	Th-4(5) or Th-4(4)+ Pract-1(4)			1 (4/5/6)			1 (4)	52	{184}  Bachelor (Research) in Faculty
	VIII	Th-4(5) or Th-4(4)+ Pract-1(4)						1 (4)		
5	IX	Th-4(5) or Th-4(4)+ Pract-1(4)						1 (4)	48	{232}  Master in Faculty
	X	Th-4(5) or Th-4(4)+ Pract-1(4)						1 (4)		
6	XI	Th-2 (6)	Th-1(4) Research Methodology					1 Semiproj for Res. (Qualifying) Project 16		{248}  PGDR in Subject
6,7,8	XII-XVI							Ph. D Thesis		Ph.D. in Subject

**DR. BHIMRAO AMBEDKAR UNIVERSITY, AGRA**  
(Formerly Agra University, Agra)

**Prof. B.P. Singh**  
HEAD



**Department of Physics**  
**Institute of Basic Sciences**  
Khandari, Agra-282002  
Phone: 9837019242, 8394900007  
E-Mail: drbps.ibs@gmail.com

22-04-2022

To,

- 1- **External Expert:** Prof. Sukhdev Rai,  
Dayalbagh Educational Institute, Agra
- 2- **External Expert:** Dr. S.N. Dolia,  
Physics Department, Rajasthan University, Jaipur.
- 3- **Local Expert Member:** Dr. Gaurang Mishra  
Physics Department, Agra College, Agra
- 4- **Internal Expert:** Prof. Bindu Shekhar Sharma,  
Physics Department, Institute of Basic Sciences, Khandari, Agra.

Dear Sir,

It gives me pleasure to inform you that you are an expert member of the Academic Committee of Physics Department, Institute of Basic Sciences, Dr. Bhimrao Ambedkar University, Khandari Campus, Agra. A meeting of the Academic Committee has been fixed on 29<sup>th</sup> April, 2022 at 03:00 PM in the Department of Physics, Institute of Basic Sciences, Khandari Campus, Agra.

You are requested to kindly attend the meeting of the Academic Committee as per program. You can also join the meeting online. The link for the meeting will be send you on the same day before on your e-mail and on your mobile no.

With best regards,

Yours faithfully,

**Prof. B.P Singh**

HOD & Convener

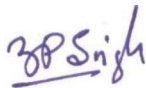
**PHYSICS DEPARTMENT**  
**INSTITUTE OF BASIC SCIENCES**  
**DR. B.R. AMBEDKAR UNIVERSITY,**  
**KHANDARI CAMPUS, AGRA**

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**AGENDA OF ACADEMIC COMMITTEE MEETING OF PHYSICS**  
**DEPARTMENT TO BE HELD ON 13-01-2021**

The following items shall be considered:

1. Minutes of last meeting of the Academic Committee dated 12-01-2021 to be confirmed.
2. To revise the syllabus and ordinances of Pre-Ph.D. Course Work /PGDR (Physics) and **M.Sc. (Physics) Course according to National Education Policy 2020 (NEP-2020)**.
3. Proposal for the beginning of Undergraduate course (B.Sc./I,II,III Year) in Physics with the collaboration of other faculty subjects.
4. Panel of Experts for thesis evaluation of following Ph.D. students
  1. Ms. Shalini Dubey.
  2. Rishi Kant Saxena



**Prof. B.P Singh**

HOD & Convener

**Minutes of the meeting of the Academic Committee of the Physics Department, Institute of Basic Sciences (Dr. B. R. Ambedkar University), Agra held on Saturday 29-04-2021**

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1. Minutes of Academic Committee held on 12-01-2021 have been confirmed. (Appendix-I)
2. As per the Govt. Order No. 401/70-3-2022 dated 09.02.2022 the National Education Policy 2020 (NEP-2020) is implemented in the Ph.D. Course of Physics from the session 2022-23. This GO with NEP-2020 rules and regulations is accepted by the Academic Committee/Board of study of Physics subject for Ph.D. course running in the Department/University. The detailed syllabus and ordinances for Pre-Ph.D. course work/PGDR is attached as **Appendix-II**.
3. As per the Govt. Order No. 401/70-3-2022 dated 09.02.2022 the National Education Policy 2020 (NEP-2020) is implemented in Post-Graduation (M.Sc. Physics) from the session 2022-23. This GO with NEP-2020 rules and regulations is accepted by the Academic Committee/Board of study of Physics subject for Post-Graduation (M.Sc. Physics) courses running in the Department/University Colleges. The detailed syllabus and ordinances for M.Sc. Physics are attached as **Appendix-III**.
3. As per the Govt. Order the National Education Policy 2020 (NEP-2020) Under-Graduate Course will be started in the Physics Department from the session 2022-23. This GO with NEP-2020 syllabus and ordinances is accepted for Under-Graduation course for Physics started in the Physics Department from the session 2022-23. The detailed syllabus and ordinances are attached as **Appendix-IV**.
4. The detailed procedure for running of under graduation course will be finalized with the other department of the subject with supervision of Dean Science.
5. The syllabus and Ordinance of Pre-Ph.D. Course work/PGDR is revised as per the National Education Policy 2020 (NEP-2020) (Appendix-V)
5. Recommendation of Panel of Examiners for Ph.D. Thesis evaluation of Ms. Shalini Dubey under the supervision of Prof. B.P. Singh is proposed. (Appendix-VI)
6. Recommendation of Panel of Examiners for Ph.D. Thesis evaluation of Mr. Rishi Kant Saxena under the supervision of Dr. K.Y. Singh is proposed. (Appendix-VII)

*joined online*  
**Prof. Sukhdev Rai**  
(External Expert)  
(Joined online)

*joined online*  
**Dr. S.N. Dolia**  
(External Expert)  
(joined online)

*Amishra*  
**Dr. Gaurang Mishra**  
(Local Expert)

*Sharma*  
*29.4.2022*  
**Prof. Bindu Shekhar Sharma**  
(Internal Member)

*29/4/22*  
**Prof. B.P. Singh**  
H.O.D. & Convener  
**Dr. B. P. SINGH**  
Professor & Head  
Department of Physics  
Institute of Basic Science, Khandwa  
Dr. B.R. Ambedkar University, Agra-28201



**Minutes of the meeting of the Academic Committee of the Physics Department,  
Institute of Basic Sciences (Dr. B. R. Ambedkar University), Agra held  
on Tuesday 12-01-2021**

1. Minutes of Academic Committee held on 12-02-2020 have been confirmed. **(Appendix-I)**
2. Due to State Govt. orders and Covid-19 pandemic situations, M.Phil. Physics Syllabus is reduced by 20% only for the Academic session 2020-21. The deleted topics in various papers of all the semesters are underlined in the syllabus. Also, in the ordinance, the point related to examination time and no of questions attempted by the students are modified. These changes in the syllabus of all the papers and following revision in the Ordinances of M.Phil. (Physics) for the session 2020-21 have been recommended and approved: **(Appendix-II)**
  - (a) **Point 8 should now be read as:**
    8. Each core or elective course shall be of 100 marks (4 credits). Out of these marks, 20 marks in each course shall be awarded on the basis of at least two periodical tests to be conducted by the teacher concerned during the semester and in addition twenty marks shall be awarded on the basis of assignment/Tutorials in each theory paper.  
At end of each semester there shall be a term examination of **Two** hours duration for each course and the same shall carry 60 marks.
  - (b) **Point 9 should now be read as:**
    9. Question paper for each course shall contain eight questions spread uniformly over the entire syllabus. The student shall have to answer only **Four** questions.
3. Due to State Govt. orders and Covid-19 pandemic situations, M.Sc. Physics Syllabus is reduced by 20% only for the Academic session 2020-21. The deleted topics in various papers of all the semesters are underlined in the syllabus. Also, in the ordinance, the point related to examination time and no of questions attempted by the students are modified. These changes in the syllabus of all the papers and following revision in the Ordinances of M.Phil. (Physics) for the session 2020-21 have been recommended and approved: **(Appendix-III)**
  - (a) **Point 8 should now be read as:**
    8. At the end of each Semester there shall be a End-Term Examination of **Two** hours duration for each course and practical of **Four** hours, based on prescribed courses taught during the Semester.
  - (b) **Point 15(a) should now be read as:**
    - 15(a). Each theory paper of the Course shall contain 8 (eight) questions spread uniformly over the entire syllabus. The students shall have to answer only **4 (four)** questions in **Two** hours, which shall be the duration of the question paper.
5. Recommendation of Panel of Examiners for Ph.D. Thesis evaluation of Mr. Preeti Sharma is proposed. **(Appendix-IV)**

*Connected online*

**Prof. Sukhdev Rai**  
(External Expert)

*Connected online*

**Dr. S.N. Dolia**  
(External Expert)

*Sharma*

**Dr. Neera Sharma**  
(Supervisor)

*BS Sharma*  
*12-01-2021*

**Prof. Bindu Shekhar Sharma**  
(Internal Member)

*12/1/21*

**Dr. B. P. SINGH**  
Prof. B.P. Singh & Head  
Department of Physics  
H.O.D. & Convener  
Institute of Basic Science, Khandari  
Dr. B.R. Ambedkar University, Agra-282002

# **DR. BHIMRAO AMBEDKAR UNIVERSITY, AGRA**

## **Pre-Ph.D. Course Work of PHYSICS**



**Under**

## **NATIONAL EDUCATION POLICY**

**2020**

**Unit-I**

Introduction of Materials, Modeling a material, Properties of Materials: Mechanical properties, Chemical properties, Electrical properties, Thermal properties, Magnetic properties, Optical properties

**Unit-II**

Thermal Expansion, Models for Thermal Expansion, Electrical Conductivity, Conductivity measurement, Free Electron Gas and the Ideal Gas, The Drude Model, Large systems

**Unit-III**

Anisotropy in Crystalline Solids, Periodic Potential in Crystalline Solids, Confinement and Quantization, Crystal Imperfections

**Unit-IV**

Deformation of Materials, Elastic deformation, Plastic deformation, Deformation in polycrystalline metals, Bauschinger effect, Cold-Working, Hot-Working

**Unit-V**

Phase transformation, Rate of transformation, Nucleation, Applications of Phase transformation, Martensitic transformation

**Unit-VI**

Corrosion, Factors influencing corrosion, Types of corrosion, Control and prevention of corrosion

**Recommended References:**

1. Physics of Materials by Prathap Haridoss (Wileys)
2. Physics of Materials by by Yves Quere (CRC)
3. Materials Science by Narula & Gupta (TMH)
4. Solid State Physics by Kittel

**Unit-I**

Introduction of renewable energy resources and the technologies, Various renewable energy source viz hydro-electric, wind, geothermal, ocean thermal, wave, tidal and biomass energy.

**Unit-II**

Fuel-cell and heat pump systems. Energy efficiency and energy storage. The potential of using renewable energy technologies as a complement to and replacement for conventional technologies, and the possibility of combining renewable and non-renewable energy technologies in hybrid systems,\

**Unit-III**

Energy Sources, Solar Electricity, Solar thermal design, PV and hybrid system design, Passive solar energy technology,

**Unit-IV**

Generators, Electrical Fundamentals, The Charge Controller and Inverter, Microwave Sensors, The Electrical Power Grid, Exergy Analysis

**Unit-V**

Solar Cells: Basic structure of solar cells, Working principle of solar cells, Solar Cell Parameters; Losses and Efficiency limits; Types of solar cells: Crystalline Silicon Solar Cells and Thin Film Solar Cells

**Unit-VI**

Energy Storing devices, Types, Working principle, Battery in PV systems, Battery problem areas, Battery maintenance, Battery safety precautions, Battery controlling technologies

**Recommended References:**

1. Solar Energy by Robert Foster (CRC)
2. The Physics of Solar Cells by Juan Bisquert
3. Handbook of Solar Energy by GN Tiwari, Arvind Tewari & Shyam
4. Solar Energy Engineering by Soteris Kalogirou

**Unit-I: Research Methodology: An Introduction & Overview**

Research Methodology, Meaning of Research, Scientific Thinking, Research Fundamentals and Terminology, Objectives of Research, Types of research, Significance of research, Criteria of good research, Basis of selection of the broad areas of research, selection of Institute, Selection of research supervisor, Basic knowledge of organizing conferences, symposia, workshop, exhibitions etc.

**Unit-II: Identifying the Research Problem**

What is research problem, Selection of the problem, Technique involved in defining a problem, Formulation of hypothesis, Meaning and need for research design, Basic principles of research design, Execution of the research, Collection and analysis of data, Conclusion of data, Different types of errors and their elimination. Developing a research proposal,

**Unit-III: Planning & Designing of Research Study**

Research papers and reviews, Different steps in writing report, Layout of the research report, types of reports and articles, Mechanics and precautions of writing research reports, References, Abstraction of a research paper, possible ways of getting oneself abreast of current literature. High rank Journals, Impact Factors, h – factor, Citation Index.

**Unit-IV: Data Collections, Assessment method & Measurements Strategies**

Methods Collection of Data, Analysis of Data, Selection of Data, Measurement, Scales of measurement, Reliability and Validity and their relationship to measurement, Measurement strategies for data collection

**Unit-V: Ethical Consideration & Plagiarism**

Intellectual property and Intellectual property rights, Indian patent system, Research agreement, Ethical theory and applications, Ethical issues in science research and reporting the problem of plagiarism and related issues, International norms and standards.

**Unit-VI: Computer Applications of Physics Research**

Applications of various softwares for Physics research viz Microsoft Office, Origin, COMSOL, PVSYST, SCAPS

**Recommended References:**

1. Research Methodology: Methods and Techniques By C.R. Kothari.
2. Thesis and Assignment writing By J. Anderson and M. Poole.
4. Research Methodology By Deepak Kumar Bhattacharya.
5. The Ethics of Science: An Introduction. David B Resnik.

**DR. BHIM RAO AMBEDKAR UNIVERSITY  
AGRA**

**M.Sc. PHYSICS SYLLABUS  
(Effective from 2022)**



**UNDER  
NATIONAL EDUCATION POLICY  
2020**

<b>M.Sc. PHYSICS COURSE STRUCTURE</b>	
<b>DEGREE</b>	
<b>BACHELOR (RESEARCH) OF SCIENCE IN PHYSICS</b>	
<b>FOURTH YEAR</b>	<p style="text-align: center;"><b><u>SEMESTER VII</u></b></p> <ul style="list-style-type: none"> <li>• 4 Theory Papers (Compulsory) of 4 Credits each.</li> <li>• 1 Practical Paper (Compulsory) of 4 Credits.</li> <li>• <b>1 Research Project of 4 Credits.</b></li> </ul> <p style="text-align: center;"><b><u>SEMESTER VIII</u></b></p> <ul style="list-style-type: none"> <li>• 3 Theory Papers (Compulsory) of 4 Credits each.</li> <li>• 1 Theory Paper (Optional Paper) of 4 Credits.</li> <li>• 1 Practical Paper (Compulsory) of 4 Credits.</li> <li>• <b>1 Research Project of 4 Credits.</b></li> </ul> <p style="text-align: center;"><b><u>NOTE</u></b></p> <p>* <u>1 Minor Paper</u>, either in Semester VII or VIII, <u>from Other Faculty</u>, of minimum 4 Credits.</p> <p>* <u>Combined Project Report / Dissertation</u> of Semester VII and VIII will be <u>evaluated together</u> at the <u>end of Fourth Year</u> by the <u>internal and external examiners</u>.</p>
<b>DEGREE</b>	
<b>MASTER OF SCIENCE IN PHYSICS</b>	
<b>FIFTH YEAR</b>	<p style="text-align: center;"><b><u>SEMESTER IX</u></b></p> <ul style="list-style-type: none"> <li>• One Specialization Branch is to be selected.</li> <li>• There will be 4 Theory Papers known as Specialization Papers (Two in each Semester IX &amp; X) and 2 Practical Papers known as Specialization Labs (One in each Semester IX &amp; X) related with the selected Specialization Branch.</li> </ul> <ul style="list-style-type: none"> <li>• 2 Theory Papers (Compulsory) of 4 Credits each.</li> <li>• 2 Theory Papers (Specialization Paper) of 4 Credits each.</li> <li>• 1 Practical Paper (Specialization Lab) of 4 Credits.</li> <li>• <b>1 Research Project of 4 Credits.</b></li> </ul> <p style="text-align: center;"><b><u>SEMESTER X</u></b></p> <ul style="list-style-type: none"> <li>• 2 Theory Papers (Compulsory) of 4 Credits each.</li> <li>• 2 Theory Papers (Specialization Papers) of 4 Credits each.</li> <li>• 1 Practical Paper (Specialization Lab) of 4 Credits.</li> <li>• <b>1 Research Project of 4 Credits.</b></li> </ul> <p style="text-align: center;"><b><u>NOTE</u></b></p>

	<p>* <u>Combined Project Report / Dissertation of Semester IX and X will be evaluated together at the end of Fifth Year by internal and external examiners.</u></p>
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SEMESTER-WISE TITLES OF THE PAPERS IN DEGREE BACHELOR (RESEARCH) OF SCIENCE IN PHYSICS						
YEAR	SEMESTER	CODE	PAPER TITLE	THEORY / PRACTICAL	CREDIT	MARKS (25+75) #
<b>FOURTH YEAR</b>	<b>VII</b>	PH 411 T	Mathematical Methods In Physics	Theory	4	100
		PH 412 T	Classical Physics	Theory	4	100
		PH 413 T	Atomic Spectra	Theory	4	100
		PH 414 T	Electrodynamics	Theory	4	100
		PH 415 P	Experimental Work	Practical	4	100
		PH 416 R	Research Project - 1	Project Work	4	--
			PH 421 T	Computational Methods In Physics	Theory	4



<b>VIII</b>	PH 422 T	Statistical Physics	Theory	4	100
	PH 423 T	Molecular Spectra	Theory	4	100
	<b>Optional Paper : Select Any One (A / B / C / D / E / F)</b>				
	PH 424A T	Relativity and Cosmology	Theory	4	100
	PH 424B T	Plasma Physics			
	PH 424C T	Laser Physics			
	PH 424D T	Semiconductor Physics			
	PH 424E T	Biophysics			
	PH 424F T	Environmental Physics			
	PH 425 P	Experimental Work	Practical	4	100
	PH 426 R	Research Project - 2	Project Work	4	--
PH 416 R + PH 426 R	Project Report / Dissertation (Combined Research Projects -1 & 2)		--	100	
<b>TOTAL FOR FOURTH YEAR</b>				<b>48 + 4*</b>	<b>1100 + 100*</b>
# 25 Marks: Internal, based on Continuous Internal Evaluation (CIE) Methods 75 Marks: External, based on End-Semester University Examinations					
* 1 Minor Paper, either in Semester VII or VIII, from Other Faculty, of minimum 4 Credits and 100 marks.					

**SEMESTER-WISE TITLES OF THE PAPERS IN  
MASTER OF SCIENCE IN PHYSICS**

YEAR	SEME- STER	CODE	PAPER TITLE	THEORY / PRACTICAL	CREDIT	MARKS (25+75) #
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A  
R**

<b>IX</b>	PH 511 T	Quantum Mechanics	Theory	4	100	
	PH 512 T	Nuclear Physics	Theory	4	100	
	<b>Specialization Paper : Select Any Set (A / B / C/ D)</b>					
	PH 513A T	Electronics - I	Theory	4	100	
	PH 513B T	Condensed Matter Physics - I				
	PH 513C T	Renewable Energy Physics - I				
	PH 513D T	Nanophysics - I				
	PH 514A T	Electronics - II	Theory	4	100	
	PH 514B T	Condensed Matter Physics - II				
	PH 514C T	Renewable Energy Physics - II				
	PH 514D T	Nanophysics - II				
	PH 515 P	Experimental Work	Practical	4	100	
	PH 516 R	Research Project - 3	Project Work	4	--	
	<b>X</b>	PH 521 T	Advanced Quantum Mechanics	Theory	4	100
		PH 522 T	Particle Physics	Theory	4	100
		<b>Specialization Paper : As Selected in IX Semester</b>				
PH 523A T		Electronics - III	Theory	4	100	
PH 523B T		Condensed Matter Physics - III				
PH 523C T		Renewable Energy Physics - III				
PH 523D T		Nanophysics - III				

	PH 524A T	Electronics - IV	Theory	4	100
	PH 524B T	Condensed Matter Physics - IV			
	PH 524C T	Renewable Energy Physics - IV			
	PH 524D T	Nanophysics - IV			
	PH 525 P	Experimental Work	Practical	4	100
	PH 526 R	Research Project - 4	Project Work	4	--
	PH 516 R + PH 526 R	Project Report / Dissertation (Combined Research Projects - 3 & 4)		--	100
	<b>TOTAL FOR FIFTH YEAR</b>			<b>48</b>	<b>1100</b>
<p># 25 Marks: Internal, based on Continuous Internal Evaluation (CIE) Methods 75 Marks: External, based on End-Semester University Examinations</p>					

**PH 411 T**  
**MATHEMATICAL METHODS IN PHYSICS**

**UNIT I:**

Linear vector spaces , basis and dimension. Linear product spaces, orthogonality, Linear independence & orthogonality of vectors, Matrices and special matrices, Inverse ,orthogonal and unitary matrices. Eigenvalues & eigenvectors of matrices and Cayley-Hamilton theorem. Diagonalization of matrices.

**UNIT II:**

Differential Equations And Special Functions; Solution by series expansion of Hermite, Bessel, Legendre, Associated Legendre, Laguerre and Associated Laguerre differential equations, Basic properties ( generating functions, recurrence & orthogonality relations and series expansion) of Hermite, Bessel, Legendre, Associated Legendre, Laguerre and Associated Laguerre functions.

**UNIT III:**

Laplace Transform: Introduction and properties (linearity, shifting and change of scale). Laplace transform of derivatives and integrals of a function. Differentiation and integration of Laplace transform. Inverse Laplace transforms. Fourier Transform: Introduction and properties (linearity, shifting, change of scale and modulation). Inverse Fourier transforms. Fourier sine & cosine transforms. Fourier integral and Fourier sine & cosine integrals.

#### **UNIT IV:**

Functions of a complex variable and analytic functions. Cauchy-Riemann conditions. Integration in the complex plane, Cauchy's integral theorem and Cauchy's integral formula. Taylor and Laurent series, Ordinary, singular and isolated singular points. Definition and evaluation of residues. Cauchy's residue theorem and Jordan's lemma. Application of Cauchy's residue theorem to the evaluation of definite integrals.

#### **SUGGESTED READINGS:**

1. G. Arfken: Mathematical Methods for Physicists
2. J. Mathews and R.L. Walker: Mathematical Methods of Physics
3. G.F. Simmons: Differential Equations with Applications and Historical Notes
4. W.W. Bell: Special Functions for Scientists and Engineers
5. R.V. Churchill and J.W. Brown: Complex variables and Applications

### **PH 412 T CLASSICAL PHYSICS**

#### **UNIT I:**

Preliminaries, Newtonian Mechanics of one and many particle systems, conservation laws, Constraints, their classification, D' Alembert's principle, generalized Co-ordinate & momenta, Lagrange's equations, Hamiltonian and Hamiltonian equations

#### **UNIT II:**

Rotating frames, inertial forces, Terrestrial and astronomical applications of Coriolis force, Central force (Definition and Characteristics), Two body problem, closure and stability of circular orbits, general analysis of orbits, Kepler's laws and equation, artificial Satellites; Rutherford scattering

#### **UNIT III:**

Principle of least action, derivation of equation of motion: variation and end points, Hamilton's principle and Characteristic functions, Hamilton Jacobi equation

#### **UNIT IV:**

Canonical transformation; generating functions Properties; group property; examples; infinitesimal generators, Poisson Brackett, Poisson themes, angular momentum, Poisson Bracket, small oscillations, normal modes and co-ordinates

**SUGGESTED READINGS:**

1. H. Goldstein: Classical Mechanics
2. N.C. Rana and P.J. Joag: Classical Mechanics
3. D. Strauch: Classical Mechanics-An Introduction

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**PH 413 T  
ATOMIC SPECTRA****UNIT I:**

Review of Bohr's model for single valence electron systems and quantum mechanical treatment of Hydrogen atom, Concept of spin of electron, Pauli's exclusion principle & periodic table, Origin & Significance of various quantum numbers for single valence electron systems, Parity of eigenfunctions, Orbital, spin & total magnetic dipole moments of electron and Lande's g factor. Larmor theorem

**UNIT II:**

Spectra of alkali elements, Screening constant, Theory of Fine Structure: Spin-orbit interaction energy, corresponding term shift & doublet separation. Relativistic correction energy, Selection rules, allowed transitions & intensity rules, Fine structure of Sodium D line. Fine structure of Hydrogen H-alpha line & Lamb shift, Theory of Hyperfine Structure: Isotopic effect, Energy order of hyperfine structure levels & selection rules.

**UNIT III:**

Theory of non-penetrating & penetrating orbits, LS Coupling, Spectroscopic terms for non-equivalent & equivalent electrons, Spin-spin , orbit-orbit & spin-orbit interaction energies, Lande's interval rule, JJ Coupling, Spectra of Alkaline Earth Elements: Singlet & triplet structure of spectra.

#### **UNIT IV:**

Zeeman Effect: Introduction (normal & anomalous Zeeman effects), Magnetic interaction energy & corresponding term shift. Selection rules, intensity rules & polarisation rules. Anomalous Zeeman effect of fine structure of Sodium D line, Paschan-Back Effect and Stark Effect

#### **SUGGESTED READINGS:**

1. H.E. White: Introduction to Atomic Spectra
2. Gerhard Herzberg: Atomic Spectra and Atomic Structure
3. Bransden and Joachain: Physics of Atoms and Molecules

## **PH 414 T ELECTRODYNAMICS**

#### **UNIT I:**

Concept of radiation & power radiated by an accelerated point charge (Larmor's & Lienard's formula), Angular distribution of power radiated by an accelerated point charge, Special case of linear acceleration (Bremsstrahlung radiation) and circular acceleration (synchrotron radiation)

#### **UNIT II:**

Electric polarization of a dielectric and polarizability, Clausius-Mossotti relation & Langevin-Debye theory and Debye equation, Dipole-dipole interaction, Laplace equation, boundary conditions and uniqueness theorems, Solution of Laplace equation in spherical coordinates

#### **UNIT III:**

Maxwell's equations in terms of electromagnetic potentials, Gauge transformation and invariance of Maxwell's equations under gauge transformation. Maxwell's equations in Coulomb and Lorentz gauge, retarded potentials, electromagnetic potentials (Lienard-Wiechert potentials) and fields due to a moving point charge.

## **UNIT IV:**

Review of Lorentz Transformation (LT) in Minkowski space and 4-vectors, Lorentz invariants (4D scalar product, 4D volume, d' Alembertian and electric charge), Current density 4-vector, LT of current & charge densities, Equation of continuity in terms of current density 4-vector, Potential 4-vector, LT of electromagnetic potentials, Lorentz condition in terms of potential 4vector and its invariance under LT, Maxwell's equations in terms of electromagnetic field tensor and their invariance under LT.

## **SUGGESTED READINGS:**

1. D.J. Griffiths: Introduction to Electrodynamics
2. J.D. Jackson: Classical Electrodynamics
3. Lev Landau: Electrodynamics of continuous media

## **PH 421 T COMPUTATIONAL METHODS IN PHYSICS**

## **UNIT I:**

Methods for determination of zeros of linear and non linear algebraic equations and transcendental equation, convergence of solutions, solution of simultaneous linear equations, interpolation with equally spaced and unevenly spaced points, curve fitting, polynomial least squares and cubic spline fitting

## **UNIT II:**

Introduction and review of matrix operations, direct methods, Matrix inversion method, Gauss elimination method and Gauss-Jordan method. Iterative Methods, Jacobi method of iteration and Gauss-Seidel iteration method, eigen value and eigen vectors of matrices.

## **UNIT III:**

Numerical Differentiation, derivatives using Newton's forward & backward difference formula, derivatives using Stirling's formula, Numerical Integration, Trapezoidal rule, Simpson's 1/3 rule, Newton-Cotes integration formula



## **UNIT IV:**

Ordinary Differential Equations: Introduction; Power series solution method; Euler's method; Runge Kutta methods, Predictor and corrector method, elementary ideas of solutions of Partial Differential Equations

### **SUGGESTED READINGS:**

1. S.S. Sastry: Introductory Methods of Numerical Analysis
2. R.L. Burden and J.D. Faires: Numerical Analysis
3. E. Isaacson and H.B. Keller: Analysis of Numerical Methods
4. W. Cheney and D. Kincaid: Numerical Methods and Computing

**PH 422 T**  
**STATISTICAL PHYSICS**

**UNIT I:**

Specification of states of a system, macroscopic and microscopic states, phase space, trajectories, density of states, Liouville's Theorem, Contact between statistics and thermodynamics, classical ideal gas, entropy of mixing, Gibb's paradox.

**UNIT II:**

Microcanonical ensemble, system in contact with heat reservoir, canonical ensemble, application of canonical ensembles, system with specified mean energy, calculation of mean values and fluctuation in a canonical ensemble, connection with thermodynamics, Grand Canonical ensemble, physical interpretation of  $\alpha$ , chemical potential in the equilibrium state, mean values and fluctuations in grand canonical ensemble, Thermodynamic functions in terms of the Grand Partition function.

**UNIT III:**

Statistics of indistinguishable particles, Quantum distribution of functions (Maxwell-Boltzmann, Fermi Dirac and Bose-Einstein Statistics), Properties of ideal Bose and Fermi gases, Bose-Einstein Condensation, Evaluation of the partition function and its application to the Ising model.

**UNIT IV:**

Landau theory of phase transition, critical indices, fluctuations and transport phenomena, Brownian motion, Langevin theory, The Fokker-Planck equation, Fluctuation dissipation theorem.

**SUGGESTED READINGS:**

1. R.K. Pathria and P.D. Beale: Statistical Mechanics
2. C. Kittel: Elementary Statistical Physics
3. K. Huang: Introduction to Statistical Physics
4. F. Reif: Statistical Physics

**PH 423 T**  
**MOLECULAR SPECTRA**

**UNIT I:**

Types of molecules; Linear and diatomic molecules, symmetric top, asymmetric top and spherical top molecules, Pure Rotational Spectroscopy: Salient features, Rotational energy levels of diatomic molecules under rigid rotator & non-rigid rotator models, Rotational quantum numbers & selection rules, Isotope effect, Intensity of spectral lines, Energy level diagram & spectral structure.

**UNIT II:**

Vibrational Spectroscopy, Salient features. Vibrational energy levels of diatomic molecules under harmonic & anharmonic oscillator models, Vibrational quantum numbers & selection rules, Intensity of spectral lines, Energy level diagram & spectral structure, Applications of vibrational spectroscopy.

**UNIT III:**

Electronic-Vibrational Spectroscopy of Diatomic Molecules: Salient features, Electronic-Vibrational energy levels of diatomic molecules, Selection rules, spectral structure, Intensity of spectral lines, Franck-Condon Principle, predissociation & dissociation energy, dissociation limit

**UNIT IV:**

Raman Spectroscopy: Salient features, Experimental arrangement, quantum theory of Raman effect, rotational, vibrational & vibrational-rotational Raman Spectra for linear molecules. Stokes & anti Stokes Raman lines. Selection rules. Energy level diagram & spectral structure, Mechanism of Fluorescent and Phosphorescent emission

**SUGGESTED READINGS:**

1. C.N. Banwell and E. McCash: Fundamentals of Molecular Spectroscopy
2. G. Aruldhes: Molecular Structure and Spectroscopy
3. J.M. Hollas: Molecular Spectroscopy

**PH 424A T**  
**RELATIVITY AND COSMOLOGY**

**UNIT I:**

Tensor Algebra: Principle of invariance of physical laws w.r.t. different coordinate systems as the basis for defining tensors. Coordinate transformations, contravariant, covariant & mixed tensors, index notation and summation convention. Spacetime metric (metric tensor), contraction and lowering & raising the indices, Special Relativity In Inertial Frames and Non-Inertial Frames, Distinction between special & general relativity, Euclidean & non-Euclidean geometries, Equivalence Principle and tidal forces.

**UNIT II:**

Tensor fields and concept of general covariance, Parallel transport, Christoffel symbols and affine connection of spacetime. Covariant derivative of covariant & contravariant vectors, covariant differentiation of a tensor and of metric tensor. Riemannian geometry (manifold) and Christoffel symbols in terms of metric tensor, Locally inertial coordinate systems, Path dependency of parallel transport, Riemann tensor, symmetries of Riemann tensor. Ricci tensor, scalar curvature and Einstein tensor. Bianchi identities and divergence of Einstein tensor. Condition for straightness & shortest distance, geodesic equation and geodesic deviation.

**UNIT III:**

Curved Newtonian Gravity: Poisson's equation for gravitational field, non-zero components of Ricci tensor and interpretation of gravitation force in curved Newtonian gravity, Energy-Momentum Tensor: Generalization of mass density to energy-momentum tensor, physical interpretation of components energy-momentum tensor and energy-momentum conservation law, Einstein Field Equations (EFE): Poisson's equation for gravitational field to EFE, Cosmological constant through metric compatibility. Newtonian approximation of EFE and evaluation of proportionality constant for energy-momentum tensor. Trace-reversed form of EFE. Sign conventions for EFE. Qualitative discussion of predictions of EFE.

**UNIT IV:**

Introduction to Astronomy: Overview of the night sky; Size, mass, density & temperature of astronomical objects; Olbers's paradox; Basic concepts of positional astronomy, Cosmological principles; Weyl postulates; Cosmological parameters; Static, Einstein, expanding, open & closed universe; Cosmological red shift, Hubble's law, Hubble constant, Friedmann models, Cosmic distance ladder. Qualitative Discussions On: Big bang, Early Universe (thermal history & nucleosynthesis), Various era of evolution of Universe, Cosmic microwave background radiation, Event horizon, Particle horizon.

**SUGGESTED READINGS:**

1. J. Plebanski and A. Krasinski: An Introduction to General Relativity and Cosmology
2. J.V. Narlikar: An Introduction to Relativity
3. J.V. Narlikar: An Introduction to Cosmology
4. A.K. Raychaudhuri, S. Banerji and A. Banerjee: General Relativity, Astrophysics and Cosmology

**PH 424B T**  
**PLASMA PHYSICS**

**UNIT I:**

Motion in electric field constant in space & time, Motion in magnetic field constant in space & time, Motion in electromagnetic field constant in space & time (drift velocity & drift acceleration of guiding centre and electric field drift), Motion in magnetic field constant in time but slowly varying in space through first order orbit theory (Alfven approximation), Magnetic dipole moment & magnetic flux. Magnetic mirror, magnetic mirror effect & magnetic bottle (plasma confinement), Motion in combined electric field constant in space but varying in time and magnetic field constant in space & time, Polarization drift and adiabatic invariants.

**UNIT II:**

Phase space, distribution function, homogeneous & inhomogeneous plasma and isotropic & anisotropic plasma. Average values and velocity moments of distribution function. Physical interpretations of first, second, third and fourth velocity moments of distribution function, Boltzmann Equation (BE) without & with collision effects, Macroscopic Transport Equations (MTEs) through velocity moments of BE. Derivation & interpretation of first, second & third velocity moments of BE. Solution of MTEs for cold plasma model (Magnetoionic theory) and warm plasma model (Adiabatic approximation). Magneto-Hydrodynamic Equations (MHDEs) from average values of MTEs, Simplified MHDEs, magnetic stress and pinch effect.

**UNIT III:**

Meaning and definition of Plasma, Quasineutral. Collective behaviour, Debye shielding, Debye length, Debye sphere, plasma parameter ( $\beta$ ) and plasma approximation, Criteria for system to be plasma. Plasma oscillations, electron plasma oscillations and electron plasma frequency in cold plasma model.

**UNIT IV:**

Important terms: Phase & group velocity; dispersion relation; Non-dispersive & dispersive media; Normal & anomalous dispersion; Longitudinal & transverse waves; Cut-offs & resonances. Magneto-hydrodynamic Waves: Velocity of Sound (adiabatic sound velocity), Alfven (Alfven velocity) and Magnetosonic (compressional Alfven waves) wave, Electron Waves in Cold Plasma Model: Dispersion relations for parallel & perpendicular components. Cut-offs & resonances for Right-hand Circularly polarized (RCP), Left-hand Circularly polarized (LCP), ordinary and extraordinary waves. CMA diagram. Faraday rotation, Faraday angle & uses of Faraday rotation.

**SUGGESTED READINGS:**

1. J.A. Bittencourt: Fundamental of Plasma Physics
2. F.F. Chen: Introduction to Plasma Physics and Controlled Fusion

**PH 424C T**  
**LASER PHYSICS**

**UNIT I:**

Laser Characteristics, Absorption, spontaneous and stimulated emission, population inversion, properties of laser, metastable state, monochromaticity, coherence, directionality, brightness, absorption coefficient, Einstein's coefficients, threshold condition.

**UNIT II:**

Three and Four level system and rate equations, pumping mechanics (electron beam impact, optical and current injection type), threshold pump power, relative merits and demerits of three and four level system, g-parameters of laser cavity, line broadening mechanisms, measurements of laser power, energy, wavelength, frequency, line width.

**UNIT III:**

Principle, construction, energy level diagram and working of Solid State Lasers: Ruby laser, Nd:YAG laser, Semiconductor laser, Gas Lasers: He-Ne laser, Nitrogen laser, CO<sub>2</sub> laser, Excimer laser  
Liquid Lasers: Dye Laser

**UNIT IV:**

Industrial Applications: Cutting, melting, welding, drilling, surface hardening, Medical Applications: Skin therapy, laser eye surgery, laser surgery, tumour ablation, Military Applications: Range finders, laser radar, laser gyroscope, Scientific Applications: In spectroscopy, laser deposition, optical fibre communication

**SUGGESTED READINGS:**

1. K. Thyagarajan and A. Ghatak: Lasers-Fundamentals and Applications
2. B.B. Laud: Lasers and Non-Linear Optics

**PH 424D T**  
**SEMICONDUCTOR PHYSICS**

**UNIT I:**

Basic equation for semiconductor device operation, carrier concentrations at thermal equilibrium for intrinsic and doped semiconductors, current density equations, carrier transport phenomena-mobility, resistivity and Hall effect, excess carrier generation and recombination and their lifetime.

**UNIT II:**

Types of semiconductors, Basic device technology, depletion region and depletion layer capacitance, current-voltage characteristics-ideal case-Shockley equation, generation-recombination process, high injection condition, diffusion capacitance, junction breakdown.

**UNIT III:**

Formation of transistor, basic current-voltage relationship, mathematical derivations, base transport and recombination factor, static characteristics of CB, CE, CC configurations, power-transistor-general consideration, static and dynamic characteristics of switching transistor (second breakdown), UJT, SCR, junction field effect transistors, their energy band diagram.

**UNIT IV:**

Energy band relation at metal semiconductor contacts – ideal condition and surface states, depletion layer, Schottky effects. Current transport processes-thermonic emission theory, diffusion theory and thermonic emission-Diffusion theory. General expression for barrier height- Schottky barrier, diode current-voltage measurement, metal-semiconductor IMPATT diode, ideal MIS diode-surface space charge regions and effect of metal work function.

**SUGGESTED READINGS:**

1. J.D. Ryder: Electronic Fundamentals and Applications
2. S.M. Sze and K.K. Nag: Physics of Semiconductor Devices
3. B.G. Streetman and S.K. Banerjee: Solid State Electronic Devices

**PH 424E T**  
**BIOPHYSICS**

**UNIT I:**

Types, size and roles of bio molecules, range of cell sizes and interdivision time scale, range of organisms sizes and life times, scaling laws in biology, complexity of living systems, timeline of life on earth, timescales in biological evolution.

**UNIT II:**

Dynamical systems, coupled ordinary differential equations, experiments on cellular physiology, phenomena and model of intercellular chemical dynamics, metabolism and gene regulation, cell growth and division.

**UNIT III:**

The nervous systems, electrical signals of Nerve cells, an overview of the structure and function of neurons, dynamics of a single neuron, neural networks, learning, memories as attractors of neural networks.

**UNIT IV:**

Growth of bacterial colony, ecological interactions, ecological dynamics, models of ecosystem, probability, entropy and information, application of information theory in genetics.

**SUGGESTED READINGS:**

1. P. Narayanan: Essentials of Biophysics
2. J.R. Claycomb and Jonathan Quoc P. Tran: Introductory Biohysics-Perspectives on the Living State



**PH 424F T**  
**ENVIRONMENTAL PHYSICS**

**UNIT I:**

Structure and thermodynamics of the atmosphere, transport of matter, energy and momentum in nature, stratification and stability of atmosphere, hydrostatic equilibrium, general calculation of the tropics, elements of weather and climates of India.

**UNIT II:**

Physics of radiation, interaction of light with matter, Rayleigh and Mie scattering, Laws of radiation (Kirchhoff's law, Planck's law, Wein's displacement law etc. Solar and terrestrial spectra, UV radiation, ozone depletion problem,, IR absorption, energy balance of the earth atmosphere system.

**UNIT III:**

Elementary fluid dynamics, turbulence and turbulent diffusion, factors governing air, water and noise pollution, Heat Island effect, gaseous and particulate matters, wet and dry deposition.

**UNIT IV:**

Energy source (Renewable and non-renewable) and combustion process, solar energy, wind energy, bioenergy, hydro power, fuel cell, nuclear energy, elements off weather and climate, stability and vertical motion of air, horizontal motion of air and water, pressure gradient, viscous force, inertia force, Reynold's number, Enhanced greenhouse, energy balance, a zero-dimensional greenhouse model, global climate model.

**SUGGESTED READINGS:**

1. J.L. Monteith and M.H. Unsworth: Principles of Environment Physics
2. E.Boeker:EnvironmentPhysics-SustainableEnergyandClimateChange

**PH 415 P & PH 425 P**  
**EXPERIMENTAL WORK (General Lab)**

Consolidated list of experiments for both semesters VIIth and VIIIth. The institution may add / modify the experiments of the same standard, and in addition, can also propose the online Virtual Lab experiments.

1. Y of glass plate by Cornu's method
2. Viscosity of a fluid by viscometer method
3. Velocity of ultrasonic waves in a liquid
4. Study of rotatory dispersion of quartz
5. Hall constants of metal
6. LCR at high frequencies
7. Assembly of logic gates and their verification by truth tables
8. Assembly of power supply
9. Ripple factor for different electrical and electronic circuits
10. Verification of principle of digital transformation
11. Study of basic circuits in the construction of computers
12. Study of multivibrator circuits
13. Study of passive filters
14. Study of active filters
15. High resistance by leakage method
16. Ballistic galvanometer
17. Stefan's constant
18.  $e/m$  by Thomson method
19.  $h$  by photoelectric cell
20. Michelson's interferometer
21. Fabry Perot etalon
22. Edser-Butler
23. Rayleigh Refractometer
24. Jamin's refractometer
25. Babinet Compensator
26. Fresnel's biprism
27. Grating
28. Polarization
29. Verification of Hartmann's formula
30. Verification of Fresnel's law of reflection
31. Spectra calibration by constant deviation spectrometer
32. Study of Zeeman effect
33. Virtual Experiments, related to above experiments, from the Online Virtual Labs of Ministry of Education, Government of India

**PH 511 T**

## QUANTUM MECHANICS

### UNIT I:

Properties of linear vector space & Hilbert space, Dirac algebra, Linear operators, operator algebra & special operators; Eigen values & eigen vectors of an operator; Linear superposition of eigen vectors & degeneracy; Commutator algebra & commutation relations; General form of uncertainty relation between two operators, Hermitian operators & properties, Equation of motion, Ehrenfest's theorem, Schwartz inequality, Heisenberg uncertainty relation derived from operator, The schrodinger equation for spherically symmetric potentials, Hydrogen atom, Radial equation, radial probability

### UNIT II:

Orbital angular momentum operator for spherically symmetric potentials and commutation relations, Relation between orbital angular momentum operator and rotation operator, Total angular momentum operator, ladder operators, commutation relations, eigen values and explicit form of angular momentum matrices, Intrinsic-spin angular momentum operator and commutation relations and eigen values. Pauli spins operators (matrices) and their properties. Coupling of two angular momenta, Clebsch-Gordan Coefficients and their properties

### UNIT III:

Time Independent Perturbation Theory for Non-Degenerate States, first & second order correction to eigen energy & eigen function. Applications– Anharmonic linear oscillator; normal Zeeman effect without electron spin; two electron systems (He atom), Time Independent Perturbation Theory for Degenerate States, first order correction to eigen energy, Applications–Stark effect in Hydrogen atom, Variational method, expectation value of energy, ground state of Helium

### UNIT IV:

Heitler-London theory, Application to  $H_2$  molecule, JWKB Approximation: Introduction, conditions for applicability and connection formulae, General expression for scattering problems; transmission & reflection coefficients; application to Gamow's theory of alpha decay, General expression for bound state problems; application to linear harmonic oscillator.

### SUGGESTED READINGS:

1. L.I. Schiff: Quantum Mechanics
2. N. Zetilli: Quantum Mechanics-Concepts and Applications
3. D.J. Griffiths: Introduction to Quantum Mechanics
4. A. Ghatak and S. Lokanathan: Quantum Mechanics-Theory and Applications

**PH 512 T**  
**NUCLEAR PHYSICS**

**UNIT I:**

Nucleon-Nucleon Interaction, Exchange forces and tensor forces, Meson theory of nuclear forces, nucleon-nucleon Scattering, Effective range theory, Experimental results for nucleon-nucleon scattering, Nuclear Force: Properties of nuclear force, Charge independence & concept of isospin, Yukawa interaction

**UNIT II:**

Liquid Drop Model, Bohr – wheeler theory of fission, Bethe-Weizsacker mass formula & its applications, Shell Model: Experimental evidence for shell effects, Salient features of Shell model, Single particle states (energy levels), spin-orbit interaction, spectroscopic notation, energy level diagram and reproduction of magic numbers, Applications – Ground state angular momentum & parity; Magnetic dipole moment, Schmidt lines; Electric quadrupole moment, Collective Model of Bohr and Mottelson

**UNIT III:**

Direct and compound nuclear reaction mechanism, cross sections in terms of partial wave amplitudes, compound nucleus, scattering matrix, Reciprocity theorem, Breit Wigner one level formula, Resonance scattering

**UNIT IV:**

Beta Decay, Fermi theory of beta decay; Fermi-Kurie plot; Decay constant; Sargent's law; Comparative half-life; Allowed & forbidden transitions; Selection rules (Fermi & Gamow-Teller) Electron Capture, multipole transitions, selection rules for total angular momentum & parity and probability of emission, total decay constant, conversion coefficient, selection rules and discrete spectrum. Nuclear isomerism, isomeric transitions and probability of transition.

**SUGGESTED READINGS:**

1. B.L. Cohen: Concepts of Nuclear Physics
1. S.N. Ghoshal: Nuclear Physics
2. M.K. Pal: Theory of Nuclear Structure

## **PH 513A T**

### **ELECTRONICS - I**

#### **UNIT I:**

Introduction to operational amplifier, Basic parameters, inverting and non inverting operational amplifier, simple Op-amp circuits, Application of Operational Amplifier in analog computation, operational amplifier as voltage follower.

#### **UNIT II:**

Adder, subtractor, integrator, differentiator, log amplifier, Antilog amplifier and Analog multimeter and divider circuits, RMS circuits function fitting and time function generation.

#### **UNIT III:**

Active filters, comparator, Astable, Monostable and Bistable multivibrator, Schmitt Trigger, Sample and hold circuit, triangular wave generator and wave shaping circuits

#### **UNIT IV:**

Voltage controlled oscillator, phase locked loop, voltage to frequency and frequency to voltage converter, A/D and D/A converter circuit 555 timer, Noise in ICs.

#### **SUGGESTED READINGS:**

1. G.B. Clayton: Operational Amplifiers
2. R.A. Gayakward: Op-amps and Linear Integrated Circuit Technology
3. J. Millman and C.C. Halkias: Integrated Electronics Analog and Digital Circuits and Systems

## **PH 514A T**

### **ELECTRONICS - II**

#### **UNIT I:**

Number system, codes (Grey code ASCII code and BCD code), Basic circuit logic Gate, digital IC families ( DTL, RTL, TTL, and ECL )logic circuits, analysis and system of combinational logic circuit Karnaugh map, pair, quads and octaves.

#### **UNIT II:**

Arithmetic logic circuits, half adder full adder, half subtractor and full subtractor, controller,code converters, inverter and adder subtractor circuits. Data processing circuits, multiplexers, demultiplexer, Encoder and Decoder ( 1 to 16 Decoder BCD Decoder and LED decoders).

#### **UNIT III:**

Introduction to flip flop R-S, D-T, J-K and J-K master slave flip flops, synchronous and asynchronous counter, mod counters, ring counter, serial and parallel shift registers

#### **UNIT IV:**

Introduction to semiconductor memories, RAM, ROM EPROM and their addressing techniques, Microprocessor (8085) memory and I/O interfacing

#### **SUGGESTED READINGS:**

1. D.P. Leach and A.P. Malvino: Digital Principles and Applications 2
2. R.P. Jain: Modern Digital Electronics

## **PH 513B T**

### **CONDENSED MATTER PHYSICS - I**

#### **UNIT I:**

Crystalline Solid, unit cells and direct lattice, two or three dimensional bravais lattice, closed packed structure, Interaction of X-Ray with matter absorption of X-Ray, Elastic scattering from a perfect lattice, the reciprocal lattice and its applications, Powder and rotating crystal method, crystal structure factor and intensity of diffraction Maxima.

#### **UNIT II:**

Point defects, line defects and planer (stacking) faults. The role of dislocations in plastic deformation and crystal growth. the observation of imperfection in crystals.

#### **UNIT III:**

Electrons in a periodic lattice, block theory, band theory, classification of solids, Effective mass, Tight bonding, cellular and pseudo potential methods Fermi surface.

#### **UNIT IV:**

De Hass Van Alfen effect, cyclotron resonance, magnetoresistance, Quantum hall effect, Weiss theory of ferromagnetism, spin wave and magnetic curie Weiss law for susceptibility, fermi and antiferromagnetic order domain and block-wall energy.

#### **SUGGESTED READINGS:**

1. C. Kittel: Introduction to Solid State Physics
2. H.P. Myers: Introductory Solid State Physics
3. A.J. Dekker: Solid State Physics

**PH 514B T**  
**CONDENSED MATTER PHYSICS - II**

**UNIT I:**

Inter atomic forces and lattice dynamics of simple metals, Ionic and covalent crystals, optical phonons and dielectric constants, inelastic neutron scattering, Mossbauer effect, Debye-Waller factor, Anharmonicity, Thermal expansion and thermal conductivity, interaction of electrons and phonons with photons, direct and indirect transitions, absorption in insulators, Polaritons, one phonon absorption, optical properties of metal, skin effect.

**UNIT II:**

Interaction of electrons with acoustic and optical phonons, polarons, superconductivity, manifestation of energy gap, critical temperature, persistent currents, Meissner effect, Cooper pairing due to phonons, BCS theory of superconductivity, Ginzburg-Landau theory, DC and AC Josephson effect, Vortices in type-II superconductors, high temperature superconductors.

**UNIT III:**

External Symmetry elements of crystals, concept of point groups, influence of symmetry on physical properties, electrical conductivity, space groups, experimental determination of space groups.

**UNIT IV:**

Analytical indexing, Ito's method, accurate determination of lattice parameters-least square method, Application of Powder method, oscillation and Burger's precession methods.

**SUGGESTED READINGS:**

1. C. Kittel: Introduction to Solid State Physics
2. H.P. Myers: Introductory Solid State Physics
3. A.J. Dekker: Solid State Physics



**PH 513C T**  
**RENEWABLE ENERGY PHYSICS - I**

**UNIT I:**

Solar Radiation: General Introduction, Solar Spectrum, Solar Constant, Solar Time, Solar Radiation measuring instruments- Pyrheliometer, Pyranometer; Solar Radiation on horizontal and inclined surface, Radiometric properties, Solar spectra.

**UNIT II:**

Solar Cells: Basic structure of solar cells, Working principle of solar cells, Solar Cell Parameters; Losses and Efficiency limits, Types of solar cells: Crystalline Silicon Solar Cells and Thin Film Solar Cells, PV Modules and arrays, Flat plate collectors, Concentrators.

**UNIT III:**

Thermodynamics of Solar Energy, Solar Cell Materials, Degradation of Solar Materials, Nanostructure Solar Cells.

**UNIT IV:**

Solar Energy Application: Solar Water Heating Systems; Solar House; Solar Cooling; Solar Crop Dryers.

**SUGGESTED READINGS:**

1. A. Severny: Solar Physics
2. Juan Bisquert: The Physics of Solar Cells
3. C.S. Solanki: Solar Voltaics
4. G.N. Tiwari, Arvind Tewari and Shyam: Handbook of Solar Energy

**PH 514C T**  
**RENEWABLE ENERGY PHYSICS - II**

**UNIT I:**

Energy Storage; Sensible heat storage; Latent Heat Storage, Chemical energy storage; Phase Transition thermal storage, Hydrogen storage.

**UNIT II:**

Operation principle of Battery: Basic Concepts, Electrochemical principles and reactions, Factors affecting battery performance, Battery standardization, Battery design.

**UNIT III:**

Rechargeable Batteries; Electrochemistry of rechargeable batteries, Battery types, Various battery parameters, Batteries in PV Systems.

**UNIT IV:**

Battery selection criteria, Battery problem areas, Battery maintenance, Battery safety precautions, Battery failures, Charge Controllers.

**SUGGESTED READINGS:**

1. D. Linden and T.B. Reddy: Handbook of Batteries
2. A. Smets et al: Solar Energy
3. C.J. Chen: The Physics of Solar Energy
4. G.N. Tiwari, Arvind Tewari and Shyam: Handbook of Solar Energy

## **PH 513D T NANOPHYSICS – I**

### **Unit – I:**

Definition of Nano Science and Nano Technology, Crystal structure, Role of dimension in nano-materials, Size dependence properties & Energy bands. Face centered cubic nanoparticles, particle size determination.

### **Unit – II:**

Synthesis of nano-materials- Physical, Chemical and Biological methods, Synthesis of semiconductor nano-particles by colloidal route, Sol-gel method. Idea for manufacturing of nano wires, nano sheets, nano belts.

### **Unit – III:**

Top-down and bottom up techniques, Formation of nanostructures by mechanical milling and chemical vapour deposition method, Procedures of multilayered thin-films, Nanowires and quantum dots.

### **Unit – IV:**

Carbon nanostructures, carbon clusters, structure and properties of  $C_{60}$ , Graphene, Alkali doped  $C_{60}$  Carbon nanotubes-fabrication, structure and its properties (Qualitative only), applications of carbon nanotubes.

### **SUGGESTED READINGS :**

1. Introduction of Nanotechnology By C.P. Poole Jr.
2. Nanomaterials Handbook By Y. Gogotsi.
3. Carbon Nanotubes by A. Jorio, G. Dresselhaus.
4. Nanotechnology Applications to Telecommunications and Networking By D. Minoli

**PH 514D T**  
**NANOPHYSICS - II**

**Unit – I:**

Single crystalline, Poly crystalline and amorphous structures, Crystal orientation, Unit cells, Preparation of amorphous materials, Imperfection in solids, Imperfection dependent properties of Crystals.

**Unit – II:**

Nano Composites, Nano polymers, Nano ceramics, Composite materials, Polymer matrix, metal matrix and ceramic matrix composites, Crystal structures.

**Unit – III:**

Materials and fabrication techniques of photonic band gap crystals, S fabrication of photonic crystal structure, Diffusion in solids, Transformation kinetics.

**Unit – IV:**

Metal nano particles – Types and their synthesis, Carbon nano tubes and related structures- properties, synthesis and applications, Application of Gold, Silver and Zinc oxide nanoparticles.

**SUGGESTED READINGS:**

1. Introduction to solid state Physics: C Kittel.
2. Solid State Physics: A. J. Dekker
3. Nanocomposite science and Technology, Ajayan, Schadler and Braun.

**PH 521 T**  
**ADVANCED QUANTUM MECHANICS**

**UNIT I:**

Identical Particles: Meaning of identity and consequences, Particle exchange operator, symmetric & anti symmetric wave functions, connection of spin and statistics, collision of identical particles with spin, Exchange degeneracy, Commutator of Hamiltonian & particle exchange operator. Symmetrization of wave functions, Slater determinant and Pauli's exclusion principle.

**UNIT II:**

Laboratory & centre of mass frames, differential & total scattering cross-section, Formal theory of quantum scattering, scattering amplitude, solution of Schrodinger equation by Green's function and scattering amplitude, Born approximation, condition for validity, scattering amplitude and differential scattering cross-section. Scattering by screened Coulomb potential (Rutherford's formula) and attractive square well potential, Partial wave analysis, phase shifts, scattering amplitude, total scattering cross-section and optical theorem, Evaluation of phase shift, Scattering by a hard sphere and attractive square well potential, Scattering of identical particles.

**UNIT III:**

Time Dependent Perturbation Theory, first order transition probability for constant perturbation, Fermi's Golden rule, first order harmonic perturbation, Semi-Classical Theory of Radiation Einstein Coefficients, transition rate for spontaneous emission, Introduction to theory of second quantization.

**UNIT IV:**

Klein-Gordon relativistic time dependent Schrodinger equation, equation of continuity, Dirac Equation(DE), linearization of Hamiltonian by Dirac, Properties of Dirac matrices, Solution of DE for a free particle, DE in electromagnetic field (magnetic moment of electron), DE in central field (intrinsic spin of electron and spin-orbit coupling energy), solution of DE for Hydrogen atom (energy levels) and negative energy states (Dirac's Hole theory).

**SUGGESTED READINGS:**

1. L.I. Schiff: Quantum Mechanics
2. N. Zettili: Quantum Mechanics-Concepts and Applications
3. D.J. Griffiths: Introduction to Quantum Mechanics
4. A. Ghatak and S. Lokanathan: Quantum Mechanics-Theory and Applications

**PH 522 T**  
**PARTICLE PHYSICS**

**UNIT I:**

Lie Algebra: Definition of lie algebra, Specific Lie Groups: Connection between conservation laws, symmetries & Lie groups. Specific Lie groups – Orthogonal  $O(n)$ , Special Orthogonal  $SO(n)$ , Unitary  $U(n)$  & Special Unitary  $SU(n)$ . Structure of  $SO(2)$ ,  $SO(3)$ ,  $SU(2)$  &  $SU(3)$  Lie groups. Application of Lie groups in Physics.

**UNIT II:**

Fundamental Interactions, Exchange interaction & properties of mediating quanta, Range & relative strength, Concept of antiparticles (qualitative), Classification of elementary particles based on intrinsic-spin, mass, interaction & lifetime, Families of Leptons, Mesons, Baryons & Baryon Resonances, Conservation Laws: Conservation law for mass-energy, linear momentum, angular momentum, electric charge, baryonic charge, leptonic charge, isospin (concept of multiplet), strangeness, charge conjugation, parity (space parity & intrinsic parity), time reversal, CP and CPT (CPT theorem), Gell Mann-Nishijima formula and hypercharge.

**UNIT III:**

Classification of hadrons on the basis of  $SU(3)$  group algebra, Quark hypothesis, Properties of quarks (flavours, mass, electric charge, intrinsic-spin, parity, various quantum numbers, strong charge or colour), Quark model of hadrons – Meson, Baryon octet, Baryon decuplet (baryon resonances), Elementary idea of – Gluons & glue ball; Quark confinement & asymptotic freedom

**UNIT IV:**

Detecting instruments; Ionization chamber, solid state detector, GM counter, Scintillation counter, Wilson cloud chamber, Diffusion cloud chamber, Bubble chamber. Particle accelerators; Proton synchrotron (variable field and variable frequency), Electron synchrotron and Betatron

**SUGGESTED READINGS:**

1. D.J. Griffiths: Introduction to Elementary Particles
2. D.H. Perkins: Introduction to High Energy Physics
3. F. Halzen and A.D. Martin: Quarks and Leptons-An Introductory Course in Modern Particle Physics

**PH523A T**  
**ELECTRONICS-III**

**UNIT I:**

Amplitude Modulation, modulation and demodulation techniques, frequency modulation, narrow band and wide band frequency modulation, PLL as frequency demodulator, phase modulation, Equivalence between AM, FM and PM modulation.

**UNIT II:**

Digital modulation, sampling and quantization, pulse code modulation, ASK FSK PSK and DPSK, frequency division and time division multiplexing.

**UNIT III:**

Generation of microwave by reflex klystron and semiconductor Gun diode, waveguide and cavity resonator, Microwave antenna, Microwave detector, VSWR power and dielectric measurement Isolator directional coupler, Magic Tee.

**UNIT IV:**

Satellite Orbit, Satellite frequencies, synchronous satellite, satellite communication, link factor affecting satellite communication, Transponders

**SUGGESTED READINGS:**

1. G. Kennedy and B. Davis: Electronic Communication Systems
2. J. Millman: Analog and Digital Communication Systems
3. H. Taub, D. Schilling and G. Saha: Principles of Communication Systems

**PH 524A T**  
**ELECTRONICS-IV**

**UNIT I:**

Basic radar system, Pulsed radar, Moving largest indicator radar, CW radar cross section, radar display, PPI duplexer, radar antenna, modem radar

**UNIT II:**

TV system and standard, TV bandwidth and channels, interlaced scanning and video camera tube, TV transmitter and receiver, Colour television.

**UNIT III:**

Antenna system, short-electric doublets, radiation from one pole and double aerials, Antenna parameters, Antenna array, Folded dipole application, Yagi antenna, Parasitic Antenna, Parabolic reflectors.

**UNIT IV:**

Wave propagation in isotropic media, Transmission and fibre losses in fibre, Dispersion, Optical waveguide, Optical Fibre source and detector, Coupler, Modern telephone, Optic mux.

**SUGGESTED READINGS:**

1. G. Kennedy and B. Davis: Electronic Communication Systems
2. J. Millman: Analog and Digital Communication Systems
3. H. Taub, D. Schilling and G. Saha: Principles of Communication Systems
4. R.R. Gulati: Monochrome and Colour Television
5. J. Wilson and J. Hawkes: Optoelectronics-An Introduction



**PH 515A P & PH 525A P**  
**EXPERIMENTAL WORK (Specialization Lab: Electronics)**

Consolidated list of experiments for both semesters IXth and Xth. The institution may add / modify the experiments of the same standard, and in addition, can also propose the online Virtual Lab experiments.

1. Characteristics of Field Effect Transistor (FET)
2. Characteristics of Silicon Controlled Rectifier (SCR)
3. Characteristics of Uni-Junction Transistor (UJT)
4. h parameters of Bi-Junction Transistor (BJT)
5. Transistor bias techniques
6. Transistor bias stability
7. Study of Common Emitter (CE) RC coupled amplifier
8. Study of FET amplifier
9. Study of feedback amplifier
10. Study of operational amplifier
11. Study of Wien Bridge oscillator
12. Study of multivibrators
13. Study of Hartley oscillator
14. Dielectric constant by Lecher wire
15. Study of voltage power supply with filters
16. Study of current power supply with filters
17. Study of Zener regulated voltage power supply
18. Virtual Experiments, related to above experiments, from the Online Virtual Labs of Ministry of Education, Government of India

**PH 523B T**  
**CONDENSED MATTER PHYSICS - III**

**UNIT I:**

Exotic Solids, Structure and symmetries of liquid, Liquid Crystal and amorphous solid, Aperiodic solids and Quasi Crystal, Fibonacci sequence, Penrose lattices and their extension to 3 dimension.

**UNIT II:**

Special Carbon Solids, Fullerenes and tubeless, Electronic properties of tubules, Carbon nanotube based electronic devices, Definition and properties of nanostructured Material, Method and synthesis of nanostructured materials, Quantum size effect and its applications.

**UNIT III:**

Interacting Electron Gas, Hartree and Hartree Fock approximations, correlations energy, screening, Plasma oscillations, Dielectric function of an electron gas in random phase approximation, limiting case and Friedal oscillations.

**UNIT IV:**

Electron in Surface States, Strongly interacting Fermi system, Elementary introduction to Landau's Quasi particle theory of Fermi liquid, strongly correlated electron gas, Elementary idea regarding surface state metallic surface and surface reconstructions.

**SUGGESTED READINGS:**

1. C. Kittel: Introduction to Solid State Physics
2. H.P. Myers: Introductory Solid State Physics
3. A.J. Dekker: Solid State Physics

## CONDENSED MATTER PHYSICS - IV

### UNIT I:

Disorder System in Solids, Point defect: Shallow impurity of state in semiconductor, Localized lattice vibrational states of solids, vacancies, interstitial and colour centres in ionic crystal.

### UNIT II:

Disorder in Condensed Matter, Substitutional position and topographical disorder, short and long range order, atomic correlation function and structural description of glasses and liquid, Anderson model for random system and electron localization, mobility edges

### UNIT III:

Imperfection in Crystals, Mechanism of plastic deformation in solid stress and strain field of screw and edge dislocations, Elastic energy of dislocation, forces between dislocations, stress needed to operate Frank read source, dislocation in fcc hcp and bcc lattices, partial dislocation and stacking solution in close packed structure.

### UNIT IV:

Films and Surfaces, Study of surface topography by multiple beam interferometry, conditions for accurate determination of step height and film thickness (Fizeau sringes) electrical conductivity of thin films, difference of behaviour of thin film from bulk Boltzmann transport equation (for diffused scattering) expansion for electrical conductivity for thin film elementary concept of surface crystallography scanning, tunnelling atomic force microscope.

### SUGGESTED READINGS:

1. C. Kittel: Introduction to Solid State Physics
2. H.P. Myers: Introductory Solid State Physics
3. A.J. Dekker: Solid State Physics

**PH 515B P & PH 525B P**  
**EXPERIMENTAL WORK (Specialization Lab: Condensed Matter Physics)**

Consolidated list of experiments for both semesters IXth and Xth. The institution may add / modify the experiments of the same standard, and in addition, can also propose the online Virtual Lab experiments.

1. Measurement of lattice parameters and indexing of powder photographs
2. Interpretation of transmission Laue photographs
3. Determination of orientation of a crystal by back reflection Laue method
4. Rotation /oscillation photographs and their interpretation
5. Modulus of rigidity and internal friction in metals as a function of temperature
6. To measure the cleavage step height of a crystal by multiple Fizeau fringes
7. To obtain multiple beam fringes of equal chromatic order
8. To determine magneto-resistance of a Bismuth crystal as a function of magnetic field
9. To study hysteresis in the electrical polarization of a TGS crystal
10. To measure the dislocation density of a crystal by etching
11. Conductivity of Germanium
12. Four probe method
13. Hall effect
14. Study of fluorescence materials
15. Study of ferromagnetic materials
16. Virtual Experiments, related to above experiments, from the Online Virtual Labs of Ministry of Education, Government of India

**PH 523C T**  
**RENEWABLE ENERGY PHYSICS - III**

**UNIT I:**

Solar Energy Conversion Systems, The Solar Resource, Need for Storage, Integration with Power cycle, Site Qualification, Economics and Environmental consideration.

**UNIT II:**

System Analysis, Design of major components, Overall system, Design of physical principles to the solar system based on application. The process includes idea generation, concepts election and estimation.

**UNIT III:**

Classification - Central Power Station System, Distributed PV System, Stand alone PV system, Grid Interactive PV System, small system for consumer applications, Hybrid solar PV system, Concentrator solar photovoltaic. System components – PV arrays, inverters, batteries, charge controls, net power meters. PV array installation, operation, costs, reliability.

**UNIT IV:**

Various PV Systems: Solar Water Heating Systems, Solar Flat-Plate Air Collector, Solar House, Solar Cooling, Solar Crop Dryers, Solar Distillations.

**SUGGESTED READINGS:**

1. S.W. Director: Solar Cells
2. A. Smets et al: Solar Energy
3. C.J. Chen: The Physics of Solar Energy
4. G.N. Tiwari, Arvind Tewari and Shyam: Handbook of Solar Energy

**PH 524C T**  
**RENEWABLE ENERGY PHYSICS - IV**

**UNIT I:**

Introduction to fuel cells, advantages and disadvantages of fuel cells, Fuel Cell Types, Basic Fuel Cell Operation, Fuel Cell Performance, Characterization and Modeling.

**UNIT II :**

Fuel Cell Thermodynamics, Fuel Cell Reaction Kinetics, Fuel Cell Charge Transport, Fuel Cell Mass Transport.

**UNIT III:**

Fuel Cell Modeling, Fuel Cell Characterization, Polymer Electrolyte Membrane Fuel Cell and SolidOxide Fuel Cell, PEMFC and SOFC Materials.

**UNIT IV:**

Fuel Cell Systems, Fuel Processing Subsystem Design, Thermal Management Subsystem Design, Environmental Impact of Fuel Cells.

**SUGGESTED READINGS:**

1. Fabian Wieghardt: Fuel Cells-Technology for a Clean Energy
2. C.J. Chen: The Physics of Solar Energy
3. S Srinivasan: Fuel Cells from Fundamentals to Applications
4. B. Viswanathan: Fuel Cells Principles and Applications

**PH 515C P & PH 525C P**  
**EXPERIMENTAL WORK (Specialization Lab: Renewable Energy Physics)**

Consolidated list of experiments for both semesters IXth and Xth. The institution may add / modify the experiments of the same standard, and in addition, can also propose the online Virtual Lab experiments.

1. Study of V-I variation of solar cell under various illuminations
2. Study of kinetic energy of photoelectrons as a function of frequency of incident radiation
3. Various energy analysis by PVsyst software
4. Effect of temperature on solar energy production
5. Study of solar cell colour sensitivity
6. Solar energy measurement by Pyranometer
7. Solar energy measurement using a pyr heliometer
8. Study of effect of Load on solar panel output
9. Study of solar collectors
10. Study of solar heating
11. Study of solar charge controllers
12. Study of power conditioning units for solar energy
13. Virtual Experiments, related to above experiments, from the Online Virtual Labs of Ministry of Education, Government of India

**PH 523D T**  
**NANOPHYSICS - III**

**Unit I:**

X- ray diffraction(XRD), powder and single crystal diffraction, x ray fluorescence(XRF), x ray photoelectron spectroscopy(XPS), dispersive high pressure XRD and energy dispersive x-ray analysis(EDAX).

**Unit II:**

Spectrophotometers, UV- Vis Spectrophotometers, IR Spectrophotometers, Fourier transform infrared radiation(FTIR), photoluminescence, electroluminescence and thermoluminescence spectroscopy,

**Unit III:**

Scanning electron microscopy (SEM), Transmission Electron Microscopy(TEM), High resolution TEM, Field emission SEM, electron energy spectroscopy, Thermo gravimetric analysis(TGA).

**Unit IV:**

Absorption, Spontaneous emission and stimulated emission, population inversion, semiconducting lasers, quantum well lasers and quantum dot lasers, Activators and co-activators.

**SUGGESTED READINGS:**

1. Introduction of Nanotechnology By C.P. Poole Jr.
2. Solid State Physics: A. J. Dekker
3. Handbook of nanotechnology: Bhushan (Ed.), Springer Verlag, New York (2004).



**PH 524D T**  
**NANOPHYSICS - IV**

**Unit I:**

Shape memory alloys, principle of one way and two way shape memory alloys, Important parameters in pseudo elastic transformation, shape memories alloys deformation.

**Unit II:**

Hybrid nano-materials, Magnetic particle ferrites, superhard nanocomposites, assembly of polymer nanoparticles, Functionalization of carbon nanotubes, Nanotube polymer composites.

**Unit III:**

Application of nano-devices, Resonant tunneling diodes, Single electron transistor, Modulation doped field effect transistor (MODFET), Organic light emitting devices(OLED).

**Unit IV:**

Nano sensors, Gas sensors, Pollution sensors, Photo sensors, IR detector, Biosensor, nano-materials gas discharge devices, CNT based fluid velocity sensors.

**SUGGESTED READINGS:**

1. Nanomaterials systems and applications: A.S. Eldestein and R.C. Cammarata.
2. Handbook of nanotechnology: Bhushan (Ed.), Springer Verlag, New York (2004).
3. Nanocomposite science and Technology, Ajayan, Schadler and Braun.

**PH 515D P & PH 525D P**  
**EXPERIMENTAL WORK (Specialization Lab: Nanophysics)**

Consolidated list of experiments for both semesters IXth and Xth. The institution may add / modify the experiments of the same standard, and in addition, can also propose the online Virtual Lab experiments.

1. Growth of nanoparticles by chemical routes
2. Growth of nanophase by sputtering
3. Growth of quantum dots by thermal evaporation
4. Growth of nanoparticles by mechanical milling /attrition
5. Growth of nanoparticles by nanopores templates method
6. Structure characterization of nanomaterials by determination of grain size and its distribution
7. Surface morphological characterization of nanomaterial by AFM
8. Surface morphological characterization of nanomaterial by SEM
9. Surface morphological characterization of nanomaterial by TEM
10. Measurement-R Analysis of sample using FTIR
11. Measurement and analysis of UV/Vis absorption spectrum of nanomaterials
12. Measurement and analysis of photoluminescence spectrum of nanomaterials
13. Measurement and analysis of Raman spectrum of nanomaterials
14. Measurement and analysis of photoluminescence / absorption spectrum of nanomaterials at low temperature
15. Structure characterization of nanomaterials by XRD and determination of average grain size, lattice parameter, etc.
16. Virtual Experiments, related to above experiments, from the Online Virtual Labs of Ministry of Education, Government of India