

# Manipal Centre for Natural Sciences

**Manipal Academy of Higher Education, Manipal**

*Outcomes Based Education (OBE) Framework*

**Five and a Half-Year full time Postgraduate  
Program**

**Integrated PhD - Physics**



# MANIPAL

ACADEMY of HIGHER EDUCATION

(Deemed to be University under Section 3 of the UGC Act, 1956)

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## **1. NATURE AND EXTENT OF THE PROGRAM**

Manipal Centre for Natural Sciences (MCNS) is the first dedicated “all-research” Centre to be established within the University. MCNS nurtures fundamental research in all branches of the Natural Sciences and it is a ‘Centre of Excellence’ under the Manipal Academy of Higher Education. The quality of the Academic Program is enhanced by integrating with active research. Efforts are made towards the production of quality scientific research in all branches of Natural Sciences. MCNS is striving to establish a technology-enabled learning environment. The Academic and Research Ecosystem in the centre is enhanced through the free flow of ideas and information as well as through the interaction with eminent scientists from other reputed national and international institutions. MCNS attempts to enhance the quality of Interdisciplinary Research through collaboration. MCNS promotes a culture of the work-integrated learning experience

The objective of the current integrated PhD program is to identify talented and dedicated bachelor's degree holders with a keen sense of scientific inquiry and motivate them to pursue high priority research in frontier areas of Natural Sciences. The Integrated PhD programme accepts students who have completed B.Sc/B.E./B.Tech degree with an excellent academic record, and who are strongly motivated to pursue a career in research.

## 2. PROGRAM EDUCATION OBJECTIVE (PEO)

The overall objectives of the Learning Outcomes-based Curriculum Framework (LOCF) for Integrated PhD program are as follows.

PEO No	Education Objective
PEO 1	After the successful completion of the programme, the students will be able to use their fundamental concepts and professional skills in the chosen discipline to address fundamental problems in Natural Sciences.
PEO 2	After the successful completion of the programme, the students will be able to model phenomena in Natural Sciences theoretically with expertised knowledge, and analyse the model with calculational skills and critical scientific thinking.
PEO 3	After the successful completion of the programme, the students will be able to plan and conduct experiments in modern laboratories with state-of-the-art facilities.
PEO 4	After the successful completion of the programme, the students will be able to quantitatively analyse experimental data with state-of-the-art computational facilities and statistical techniques.
PEO 5	After the successful completion of the programme, the students will be able to practice the profession with a highly professional and ethical attitude, strong communication skills, and effective professional skills to work in a team with a multidisciplinary/international environment.
PEO 6	After the successful completion of the programme, the students will be able to participate in a lifelong learning process for a highly productive career and will be able to relate the concepts in Natural Sciences towards serving the needs of the society.



**3. GRADUATE ATTRIBUTES:**

S No.	Attribute	Description
1	Disciplinary Knowledge	
2	Understanding different subsets of the chosen discipline	
3	Measurable Skills and Industry-ready Professionals	
4	Effective and Influencing communication	
5	Leadership readiness/ Qualities	
6	Critical/ Reflective thinking & language efficiency	
7	Technologically Efficient Professional	
8	Ethical Awareness	
9	Lifelong Learning	
10	Research-related Skills	
11	Cooperation/ Team work	

#### 4. QUALIFICATIONS DESCRIPTORS

1.

**PROGRAM OUTCOMES:** After successful completion of the Integrated PhD Programme, Students will be able to:

PO No	Attribute	Competency
PO 1	Domain knowledge	apply the professional knowledge to analyse and solve fundamental problems in Natural Sciences.
PO 2	Problem analysis	identify important contemporary problems in Natural Sciences.
PO 3	Design/develop solutions	design innovative theoretical models/experiments and apply professional skills in theoretical modeling and analysis, statistical data analysis and experiments to address fundamental problems in Natural Sciences.
PO 4	Conduct investigations of complex problems	divide a complex problem into a set of simpler problems so that the original problem can be solved at the end of solving all the simpler problems.
PO 5	Modern tool usage	undertake research on fundamental problems in Natural Sciences with state-of-the-art experimental/computational facilities and up-to-date theoretical techniques.
PO 6	Business and society	relate the concepts in Natural Sciences towards serving the needs of society.
PO 7	Environment and sustainability	relate the concepts in Natural Sciences towards serving the needs of sustainability.



<b>PO 8</b>	<b>Ethics</b>	undertake the profession with a highly professional and ethical attitude.
<b>PO 9</b>	<b>Individual / Team work</b>	work in a team with a multidisciplinary/international environment.
<b>PO 10</b>	<b>Communication</b>	communicate with national and international leading experts with strong communication skills and deep knowledge on the chosen discipline..
<b>PO 11</b>	<b>Project management and finance</b>	run research projects funded by external agencies as a leader.
<b>PO 12</b>	<b>Life-long learning</b>	participate in a life-long learning process for a highly productive professional career.

**PROGRAM SPECIFIC OUTCOMES:** After successful completion of the Integrated PhD Programme, Students will be able to:

<b>PSO 1</b>	identify the most important problems in Natural Sciences that can be addressed at current time, and make realistic plans to address the problems.
<b>PSO 2</b>	conduct highly original research on fundamental problems in Natural Sciences.
<b>PSO 3</b>	lead a research team in respective research fields in Natural Sciences with strong leadership and communication skills.



## Physics Discipline

### FIRST YEAR:

Semester: 1

Semester: 2

Subject Code	Subject Title	L	T	P	C	Subject Code	Subject Title	L	T	P	C
NS PH 5101	Research Methodology	3	1	0	4	NS PH 5201	Modern Physics I	3	1	0	4
NS PH 5102	Mathematical Techniques / Quantitative Analysis	3	1	0	4	NS PH 5202	Modern Physics II	3	1	0	4
NS PH 5103	Numerical Techniques & Applications	3	1	0	4	NS PH 5202/ NS PH 5203/ NS PH 5204	Elective I: Introduction to Astrophysics / Special Topics in Experimental Nuclear Physics I: Neutron Physics / Elements of Reactor Physics	3	1	0	4
NS PH 5104	Quantum Mechanics & Applications	3	1	0	4	NS PH 5210/ NS PH 5211	Elective II: Radiative Processes in Astrophysics / Advanced Reactor Physics	3	1	0	4
NS PH 5130	Lab I	0	0	6	3	NS PH 5230	Lab II	0	0	6	3
		-	-	-				-	-	-	
		-	-	-				-	-	-	
	<b>Total</b>				<b>23</b>		<b>Total</b>				<b>23</b>

*\*Open electives of MOOC are Subject to availability. Additional Electives / Courses would be added to the list of electives from time to time as recommended by Academic Review Committee of the Department*





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*\*\*Students can choose any two MOOC courses in a semester ( 2 credits each)*

*#Bridge course credits are compulsory however they are not considered in calculation of GPA*

**SECOND YEAR (FINAL YEAR):**

**Semester: 3**

**Semester: 4**

Subject Code	Subject Title	L	T	P	C	Subject Code	Subject Title	L	T	P	C
NS PH 6001	Research Project					NS PH 6001	Research Project (continued from Semester 3)				42
								-	-	-	
								-	-	-	
		-	-	-							
		-	-	-							
	<b>Total</b>						<b>Total</b>				42

*\*Open electives of MOOC are Subject to availability. Additional Electives / Courses would be added to the list of electives from time to time as recommended by Academic Review Committee of the Department*



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Name of the Institution / Department: DEPARTMENT OF XXXX

<b>Name of the Program:</b>												
<b>Course Title:</b>												
<b>Course Code:</b>		<b>Course Instructor:</b>										
<b>Academic Year:</b> 2020-2021		<b>Semester:</b> First Year, Semester 1										
<b>No of Credits:</b>		<b>Prerequisites:</b>										
<b>Synopsis:</b>												
<b>Course Outcomes (COs):</b>		On successful completion of this course, students will be able to										
CO 1:												
CO 2:												
CO 3:												
CO 4:												
CO 5:												
CO 6:												
<b>Mapping of COs to POs</b>												
COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1												
CO 2												
CO 3												
CO 4												
CO 5												
CO 6												



<b>Course content and outcomes:</b>		
<i>Content</i>	<i>Competencies</i>	<i>No of Hours</i>
<b>Unit 1:</b>		
	•	
<b>Unit 2:</b>		
	•	
<b>Unit 3:</b>		
	•	
<b>Unit 4:</b>		
	•	
<b>Unit 5:</b>		
	•	
<b>Unit 6:</b>		
	•	
<b>Learning strategies, contact hours and student learning time</b>		
<i>Learning strategy</i>	<i>Contact hours</i>	<i>Student learning time (Hrs)</i>
Lecture		
Seminar		
Small Group Discussion (SGD)		
Self-directed learning (SDL)		
Problem Based Learning (PBL)		
Case Based Learning (CBL)		
Clinic		
Practical		
Revision		



Assessment						
<b>TOTAL</b>						
<b>Assessment Methods:</b>						
<b>Formative:</b>			<b>Summative:</b>			
Class tests			Sessional examination			
Assignments/presentations			End semester examination			
Quiz						
<b>Mapping of assessment with Cos</b>						
Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6
Sessional Examination 1						
Sessional Examination 2						
Quiz						
Assignment/Presentation						
End Semester Examination						
Laboratory examination						
<b>Feedback Process</b>	<ul style="list-style-type: none"> <li>● Mid-Semester feedback</li> <li>● End-Semester Feedback</li> </ul>					
<b>Reference Material</b>	<ol style="list-style-type: none"> <li>1.</li> <li>2.</li> <li>3.</li> <li>4.</li> </ol>					



**2. PROGRAM OUTCOMES (POS) AND COURSE OUTCOMES (COS) MAPPING**

S.No.	Course Code	Course Name	Credits	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1															
2															
3															
4															
5															

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