

## الخطة التدريبية السنوية لوحدة الرنين النووي المغناطيسي بجامعة المنصورة Annual Training Plan, NMR Unit, Mansoura University

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### مقدمة:

### Introduction:

The Administrative Board of NMR Unit, Mansoura University, agreed in its meeting No. 25 on 10/16/2023, to begin the training service for researchers in the field of NMR spectroscopic measurements, and to develop a training plan and programs that meets the needs of researchers in this scientific and technical field and helps them to raise their efficiency in benefiting from these crucial and continually developing measurements for quality scientific research and publication. The plan also aims to qualify a nuclear magnetic resonance measurement specialist, and also participate in qualifying students for the labor market.

The training plan includes three training programs that cover the skills intended to be acquired to different categories of beneficiaries:

- 1- A training program for the researchers from staff academic members and their assistants, as well as graduate students, which was abbreviated as NMR-RES.
- 2- A training program for students to be prepared for the labor market, which was abbreviated as NMR-STU.
- 3- A training program to qualify a nuclear magnetic resonance measurement specialist, which was abbreviated as NMR-SP

وافق مجلس إدارة وحدة الرنين النووي المغناطيسي، جامعة المنصورة، بجلسته رقم 25 بتاريخ 2023/10/16 على البدء في الخدمة التدريبية للباحثين في مجال القياسات الطيفية للرنين النووي المغناطيسي، ووضع خطة وبرامج تدريبية تلبي احتياجات الباحثين في هذا المجال العلمي التقني ويساعدهم في رفع كفاءتهم في الاستفادة من هذه القياسات الطيفية دائمة التطور والتي لا غنى عنها لجودة البحث والنشر العلمي. كما تستهدف الخطة تأهيل متخصص قياس رنين نووي مغناطيسي، وأيضاً المشاركة في تأهيل الطلاب لسوق العمل.

تضم الخطة التدريبية ثلاثة برامج تدريبية تغطي المهارات المستهدفة إكسابها لفئات المستفيدين المختلفة:

- 1- برنامج تدريبي للسادة الباحثين من هيئة التدريس ومعاونيهم وطلاب الدراسات العليا، والذي يشار إليه بالاختصار NMR-RES.
- 2- برنامج تدريبي للطلاب تأهيلاً لسوق العمل، والذي يشار إليه بالاختصار NMR-STU.
- 3- برنامج تدريبي لتأهيل متخصص قياس رنين نووي مغناطيسي، والذي يشار إليه بالاختصار NMR-SPC.



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البرامج التدريبية : Training Programs

### NMR-RES

برنامج تدريبي للسادة الباحثين من هيئة التدريس ومعاونيهم وطلاب الدراسات العليا

A training program for the researchers from staff academic members and their assistants, as well as graduate students

#### Overview

This training program offered by the NMR Unit at Mansoura University provides researchers including faculty, research assistants and graduate students with hands-on training in NMR spectroscopy for chemical structure elucidation and analysis. The program includes courses on sample preparation, NMR spectral interpretation, and processing of 1D and 2D NMR data using the latest software. The intended outcomes are to build competence in utilizing NMR spectroscopy for research and enable researchers to acquire high quality NMR data for publication purposes.

#### Program Details

##### Courses Offered:

Serial	Title of training	Type and contents of training	Intended training outcomes, ITO On completing this training course, trainees will be able to:	Proposed Time of training	Fees of training
1	<b>Sample Preparation and Analysis Workshop</b>	<ul style="list-style-type: none"><li>• 1 day theory (6 hours)</li><li>• 1 day practical (6 hours)</li><li>• 2 days for spectrum processing</li></ul>	<ol style="list-style-type: none"><li>1. Select appropriate NMR solvents and prepare samples at suitable concentrations for analysis.</li><li>2. Perform tuning, locking, shimming, and calibration on NMR instruments.</li><li>3. Operate NMR software to set up and run 1D proton experiments.</li><li>4. Process 1D spectra using Fourier transform, phasing, baseline correction etc.</li><li>5. Identify peak multiplicities, integrate peak</li></ol>	During April	2000 EGPs for Egyptians, 2000 US\$ for Non-Egyptians

			areas, and measure coupling constants.		
2	<b><sup>1</sup>H NMR Spectral Assignment Workshop</b>	<ul style="list-style-type: none"> <li>• 2 days theory (12 hours)</li> <li>• 4 days spectrum processing</li> </ul>	<ol style="list-style-type: none"> <li>1. Explain basic NMR theory including magnetization, pulse sequences, relaxation etc.</li> <li>2. Explain chemical shift and coupling interactions in <sup>1</sup>H NMR.</li> <li>3. Select suitable 1D proton experiments for structural analysis.</li> <li>4. Assign <sup>1</sup>H signals using chemical shift prediction and coupling patterns.</li> <li>5. Identify proton spin systems and translate them into molecular substructures.</li> <li>6. Elucidate unknown molecular structures using <sup>1</sup>H NMR data.</li> </ol>	During March	3000 EGPs for Egyptians, 3000 US\$ for Non-Egyptians
3	<b><sup>13</sup>C NMR Spectral Assignment Workshop</b>	<ul style="list-style-type: none"> <li>• 3 days theory (18 hours)</li> <li>• 3 days spectrum processing</li> </ul>	<ol style="list-style-type: none"> <li>1. Explain basic NMR theory related to <sup>13</sup>C nuclei.</li> <li>2. Select suitable <sup>13</sup>C NMR experiment types (proton decoupled, DEPT).</li> <li>3. Predict chemical shifts for different structural carbons.</li> <li>4. Assign signals in <sup>13</sup>C spectra to specific carbons in molecule.</li> <li>5. Determine number of chemically non-equivalent carbons.</li> <li>6. Correlate <sup>1</sup>H and <sup>13</sup>C data using HSQC experiments.</li> <li>7. Confirm molecular structures using <sup>13</sup>C</li> </ol>	During July	3000 EGPs for Egyptians, 3000 US\$ for Non-Egyptians

			NMR data.		
4	<b>2D spectral Assignment Workshop</b>	<ul style="list-style-type: none"> <li>• 4 days theory (24 hours)</li> <li>• 4 days spectrum processing</li> </ul>	<ol style="list-style-type: none"> <li>1. Explain theory, acquisition, and use of 2D NMR experiments.</li> <li>2. Select optimal 2D experiments (COSY, HMBC, etc) to determine molecular structure.</li> <li>3. Process 2D NMR spectra and extract 2D cross peaks</li> <li>4. Assign <math>^1\text{H}</math> and <math>^{13}\text{C}</math> signals by correlating 1D and 2D NMR data.</li> <li>5. Construct molecular fragments and determine connectivity using 2D data.</li> <li>6. Confirm final molecular structures of unknowns using 2D NMR.</li> </ol>	During September	4000 EGPs for Egyptians, 4000 US\$ for Non-Egyptians
5	<b>NMR of other active nuclei Workshop</b>	<ul style="list-style-type: none"> <li>• 2 days theory (12 hours)</li> <li>• 2 days tutorial spectrum analysis</li> </ul>	<ol style="list-style-type: none"> <li>1. list the NMR active nuclei: Hydrogen (<math>^1\text{H}</math>, <math>^2\text{H}</math>, <math>^3\text{H}</math>), Helium (<math>^3\text{He}</math>), Lithium (<math>^7\text{Li}</math>), Boron (<math>^{10}\text{B}</math>, <math>^{11}\text{B}</math>), Nitrogen (<math>^{15}\text{N}</math>), Oxygen (<math>^{17}\text{O}</math>), Fluorine (<math>^{19}\text{F}</math>), Sodium (<math>^{23}\text{Na}</math>), Magnesium (<math>^{25}\text{Mg}</math>), Aluminium (<math>^{27}\text{Al}</math>), Silicon (<math>^{29}\text{Si}</math>), Phosphorus (<math>^{31}\text{P}</math>), Sulphur (<math>^{33}\text{S}</math>), Chlorine (<math>^{35}\text{Cl}</math>, <math>^{37}\text{Cl}</math>), Potassium (<math>^{39}\text{K}</math>), Calcium (<math>^{43}\text{Ca}</math>), Vanadium (<math>^{51}\text{V}</math>), Cobalt (<math>^{59}\text{Co}</math>), Cupper (<math>^{65}\text{Cu}</math>), Zinc (<math>^{67}\text{Zn}</math>), Selenium (<math>^{77}\text{Se}</math>), Bromine (<math>^{79}\text{Br}</math>, <math>^{81}\text{Br}</math>), Krypton (<math>^{83}\text{Kr}</math>), Rubidium (<math>^{87}\text{Rb}</math>), Cadmium (<math>^{111}\text{Cd}</math>, <math>^{113}\text{Cd}</math>), Iodine (<math>^{127}\text{I}</math>), Xenon (<math>^{129}\text{Xe}</math>), Caesium (<math>^{133}\text{Cs}</math>), Platinum</li> </ol>	During November	2000 EGPs for Egyptians, 2000 US\$ for Non-Egyptians



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			(195Pt), Mercury (199Hg), Thallium (205Tl), Lead (207Pb). 2. Process and analyze NMR spectra of different nuclei. 3. Determine molecular structure and properties from NMR data of various nuclei. 4. Expand NMR structural analysis capabilities using additional nuclei.		
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**Certification:** Courses completed will be indicated in a certificate issued by the NMR Unit.

**Instructors:** Courses will be conducted by NMR Unit faculty and staff with PhDs in chemistry/spectroscopy and 5+ years of experience in NMR research and training.

**Facilities:** The program will utilize the 500 MHz instrument and processing software available at the NMR Unit, in addition to MestRenova software.

**Registration and Payment:** Researchers interested in attending should register by completing the application form available at [URL] and making payment to the NMR Unit bank account at least 2 weeks before the scheduled course dates.

**Timeline:** The training program will be offered annually. Dates for upcoming courses will be announced at least 1 months in advance.

**Trainee Feedback:** End-of-course evaluations will be used to collect trainee feedback and assess satisfaction. Follow up with trainees will be conducted 6 months post-training to evaluate impact of training. Feedback will inform future improvements to the training program.



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**Program Administration:** The training program is organized and administered by the NMR Unit. An annual plan will be prepared and announced. Fees, qualifications, and course content will be reviewed annually, and updates approved by the NMR Unit Advisory/Administration Board.

### NMR-STU

برنامج تدريبي للطلاب تأهيلاً لسوق العمل

**A training program for students to be prepared for the labor market**

#### Overview

This training program offered by the NMR Unit at Mansoura University provides students with practical skills and knowledge in NMR spectroscopy to prepare them for careers requiring NMR expertise.

The program includes hands-on courses focused on developing competencies in sample preparation, data acquisition, spectral processing and basic structural analysis using NMR techniques. The intended training outcome, ITO increase employability of students in NMR-related fields.

#### Program Details

##### Courses Offered:

Serial	Title of training	Type and contents of training	Intended training outcomes, ITO On completing this training course, trainees will be able to:	Proposed Time of training	Fees of training
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1	<b>Sample Analysis Workshop</b>	<ul style="list-style-type: none"> <li>• 1 day theory (6 hours)</li> <li>• 1 day practical (6 hours)</li> <li>• 2 days spectrum processing</li> </ul>	<ol style="list-style-type: none"> <li>1. Follow lab protocols for preparation of samples for NMR analysis.</li> <li>2. Perform basic operations of NMR instruments including shimming and locking.</li> <li>3. Use NMR software to acquire and process simple 1D proton spectra.</li> <li>4. Identify major signal features in NMR spectra for basic molecular analysis.</li> </ol>	During April	2000 EGPs for Egyptians, 2000 US\$ for Non-Egyptians
2	<b><sup>1</sup>H NMR Spectral Assignment workshop</b>	<ul style="list-style-type: none"> <li>• 2 days theory (12 hours)</li> <li>• 4 days spectrum processing</li> </ul>	<ol style="list-style-type: none"> <li>1. Explain fundamental NMR theory and principles of <sup>1</sup>H NMR.</li> <li>2. Process 1D proton NMR spectra and identify key signal features.</li> <li>3. Assign signals in <sup>1</sup>H NMR spectra using chemical shift and coupling patterns.</li> <li>4. Determine basic molecular structures from analysis of <sup>1</sup>H NMR spectra.</li> </ol>	During March	3000 EGPs for Egyptians, 3000 US\$ for Non-Egyptians
3	<b><sup>13</sup>C NMR Spectral Assignment Workshop</b>	<ul style="list-style-type: none"> <li>• 3 days theory (18 hours)</li> <li>• 3 days spectrum processing</li> </ul>	<ol style="list-style-type: none"> <li>1. Explain basics of <sup>13</sup>C NMR acquisition and theory.</li> <li>2. Process and analyze simple <sup>13</sup>C NMR spectra.</li> <li>3. Assign signals in <sup>13</sup>C spectra and identify carbon types.</li> <li>4. Correlate <sup>1</sup>H and <sup>13</sup>C data to determine basic molecular structures.</li> </ol>	During July	3000 EGPs for Egyptians, 3000 US\$ for Non-Egyptians
4	<b>2D spectral Assignment Workshop</b>	<ul style="list-style-type: none"> <li>• 4 days theory (24 hours)</li> <li>• 4 days spectrum</li> </ul>	<ol style="list-style-type: none"> <li>1. Understand basic acquisition and use of simple 2D NMR experiments.</li> <li>2. Process 2D NMR spectral data under guidance</li> <li>3. Use 2D NMR data to confirm 1D NMR</li> </ol>	During September	4000 EGPs for Egyptians, 4000 US\$ for Non-



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		processing	assignments. 4. Construct molecular fragments using 2D NMR correlations. 5. Determine basic unknown structures using 2D NMR data.		Egyptians
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**Certification:** Courses completed will be indicated in a certificate issued by the NMR Unit.

**Instructors:** NMR Unit faculty and staff with expertise in NMR spectroscopy and training students.

**Facilities:** 500 MHz instrument and processing software.

**Registration:** Students should register at least 2 weeks before scheduled course dates.

**Timeline:** Courses will be offered 1-2 times annually based on demand. Course dates will be announced at least 1 months in advance.

**Trainee Feedback:** End-of-course evaluations will be collected from students. Follow up after 6 months to assess impact of training.

**Program Administration:** The training program is organized and administered by the NMR Unit. Updates are approved by the NMR Unit Advisory/Administration Board.





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### NMR-SPC

برنامج تدريبي لتأهيل متخصص قياس رنين نووي مغناطيسي

A training program to qualify a nuclear magnetic resonance measurement specialist

#### Overview

This comprehensive training program offered by the Mansoura University NMR Unit aims to develop expertise in NMR spectroscopy operations, maintenance, and advanced spectral interpretation to qualify nuclear magnetic resonance (NMR) measurement specialists. The program provides intensive hands-on training on NMR instrument, data acquisition and processing, spectral assignment, structure elucidation, and troubleshooting. Intended to produce highly skilled NMR specialists.

#### Program Details

##### Modules:

Serial	Title of training	Type and contents of training	Intended training outcomes, ITO On completing this training course, trainees will be able to:	Proposed Time of training	Fees of training
1	<b>NMR Instruments and Operations</b>	4 days of living with the device	<ol style="list-style-type: none"><li>1. Identify key components of NMR systems including magnet, console, probes.</li><li>2. Explain functions of modules like amplifiers, lock systems, shim coils</li><li>3. Prepare system by loading cryogen Dewars with liquid nitrogen and helium.</li><li>4. Check and calibrate NMR instrument conditions and settings.</li></ol>	During April	2000 EGPs for Egyptians, 2000 US\$ for Non-Egyptians

2	<b>Sample Preparation and NMR Data Acquisition</b>	workshop, 1 day theoretical, 1 day practical. 2 day processing of spectrum	<ol style="list-style-type: none"> <li>1. Follow protocols for preparation of samples for various NMR experiments -Perform tuning, matching, locking, shimming and calibration with precision.</li> <li>2. Operate NMR instruments to acquire 1D and 2D data professionally.</li> <li>3. Process NMR spectra and analyze common artifacts and errors.</li> </ol>	During April	2000 EGPs for Egyptians, 2000 US\$ for Non-Egyptians
3	<b><sup>1</sup>H NMR Spectroscopy and Structural Assignment</b>	workshop, 2 days theoretical, 4 days processing of spectra	<ol style="list-style-type: none"> <li>1. Set up and run 1D and 2D proton experiments independently.</li> <li>2. Optimize experimental parameters for <sup>1</sup>H NMR structural analysis.</li> <li>3. Assign <sup>1</sup>H NMR signals reliably using predictive models and 2D data.</li> <li>4. Identify and troubleshoot issues in <sup>1</sup>H NMR data.</li> </ol>	During March	3000 EGPs for Egyptians, 3000 US\$ for Non-Egyptians
4	<b><sup>13</sup>C NMR Spectroscopy and Structural Assignment</b>	workshop, 3 days theoretical, 3 days processing of spectra	<ol style="list-style-type: none"> <li>1. Confidently operate <sup>13</sup>C NMR experiments with decoupling</li> <li>2. Optimize parameters for <sup>13</sup>C NMR acquisition and processing</li> <li>3. Assign signals in <sup>13</sup>C NMR spectra accurately utilizing 2D data</li> <li>4. Troubleshoot and improve quality of <sup>13</sup>C NMR spectral data.</li> </ol>	During July	3000 EGPs for Egyptians, 3000 US\$ for Non-Egyptians
5	<b>2D NMR Techniques</b>	workshop, 4 days theoretical,	<ol style="list-style-type: none"> <li>1. Set up 2D experiments (COSY, HSQC, HMBC etc) independently</li> </ol>	During Septemb	4000 EGPs for Egyptians,



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		4 days processing of spectra	<ol style="list-style-type: none"><li>2. Process 2D NMR data and optimize spectral quality</li><li>3. Utilize 2D NMR for accurate assignment and structure determination</li><li>4. Critically analyze 2D NMR results and identify artifacts/errors.</li></ol>	er	4000 US\$ for Non-Egyptians
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**Instructors:** Senior NMR faculty and staff with PhD level expertise.

**Facilities:** 500 MHz NMR instrument, multiple 2D NMR capabilities.

**Application Process:** Prospective trainees should have a BSc in chemistry or related field. Selection is competitive and may be based on academic record, admission exam, and interview performance.

**Program Completion:** Trainees must demonstrate proficiency in all modules through hands-on evaluations and written exams to earn the NMR Measurement Specialist Certificate.

**Timeline:** Courses will be offered 1-2 times annually based on demand. Course dates will be announced at least 1 months in advance.

**Trainee Feedback:** Ongoing feedback and end-of-program interviews will be used to improve program quality.


**Program Administration:** The training program is organized and managed by the NMR Unit. The program is reviewed annually and updated as needed by the NMR Unit Advisory/Administration Board.

### إجراءات متابعة التنفيذ:

- 1- يدار التدريب بواسطة وحدة الرنين النووي المغناطيسي بجامعة المنصورة.
- 2- المدربون يتم اختيارهم من أعضاء هيئة التدريس والموظفين من حملة الدكتوراه ذوي الخبرة في الرنين النووي المغناطيسي.
- 3- تسهيلات التدريب يتم استخدام جهاز الرنين المغناطيسي النووي بتردد 500 ميجاهرتز، وقدرات متعددة للرنين النووي المغناطيسي ثنائي الأبعاد.
- 4- يتم الإعلان سنوياً عن الخطة والبرامج إجمالاً، ويتم التحديد الدقيق للبرنامج والإعلان عن المقررات التدريبية قبل موعد انعقادها بوقت كافي لا يقل عن شهر.
- 5- يتم تسديد رسوم التدريب (ورشة العمل أو الدورة) بحساب الوحدة لدى البنك المركزي قبل بدء المقرر التدريبي بوقت لا يقل عن أسبوعين.
- 6- يتم الترتيب الجيد لعقد التدريب، ويتم متابعة قياس أثر التدريب، والاستفادة منه في تطوير التدريب.
- 7- تصرف مكافآت للقائم بالتدريب والمشاركين والمنظمين طبقاً للنظم المعمول بها، وتعرض على مجلس الإدارة لإقرارها.
- 8- يتم مراجعة محتوى التدريب ورسوم التدريب كلما لزم الأمر بالعرض على مجلس الإدارة للموافقة.

المنصورة في 22 أكتوبر 2023

أ.د. ممدوح عبد المجيب محمد



مدير وحدة الرنين النووي المغناطيسي