

**CURRICULUM**  
**OF**  
**MECHATRONICS ENGINEERING**  
**PhD**

**(Revised 2016)**



**HIGHER EDUCATION COMMISSION**  
**ISLAMABAD**

## **CURRICULUM DIVISION, HEC**

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## PREFACE

The curriculum, with varying definitions, is a plan of the teaching-learning process that students of an academic programme are required to undergo. It includes objectives and learning outcomes, course contents, scheme of studies, teaching methodologies and methods of assessment of learning. Knowledge in all academic disciplines is expanding and even new disciplines are also emerging, it is imperative that curriculum are developed and revised regularly.

University Grants Commission (UGC) was designated as the competent authority to develop, review and revise curricula beyond Class-XII vide Section 3, Sub-Section 2 (ii), Act of Parliament No. X of 1976 titled **“Supervision of Curricula and Textbooks and Maintenance of Standard of Education”**. With the repeal of UGC Act, the same function was assigned to the Higher Education Commission (HEC) under its Ordinance of 2002, Section 10, Sub-Section 1 (v).

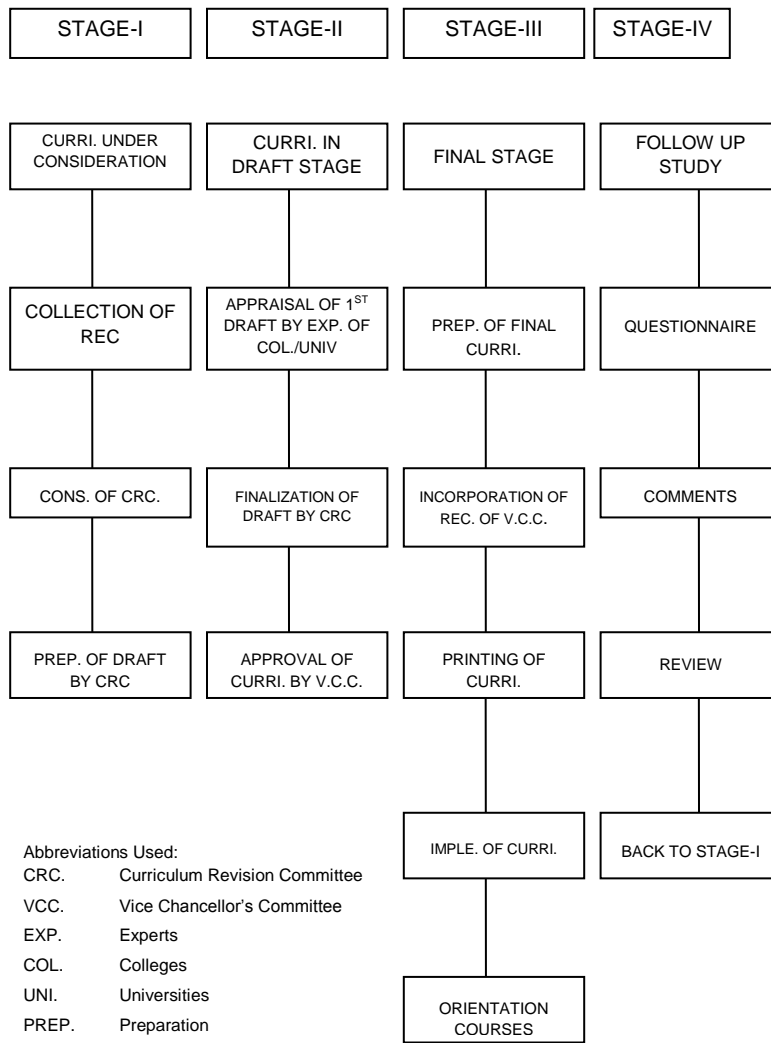
In compliance with the provisions, the Curriculum Division of HEC undertakes the revision of curricula after every three years through respective National Curriculum Revision Committees (NCRCs) which consist of eminent professors and researchers of relevant fields from public and private sector universities, R&D organizations, councils, industry and civil society nominated by their organizations.

In order to impart education at par with quality international standards, HEC NCRCs have developed unified templates as guidelines for the development and revision of curricula in the disciplines of Basic Sciences, Applied Sciences, Social Sciences, Agriculture and Engineering in 2007 and 2009.

It is hoped that this curriculum document, prepared by the respective NCRC's, would serve the purpose of meeting our national, social and economic needs, and it would also provide the level of competency specified in Pakistan Qualification Framework to make it compatible with international educational standards. The curriculum is also placed on the website of HEC ([www.hec.gov.pk](http://www.hec.gov.pk)).

**(Fida Hussain)**  
**Director General (Academics)**

## CURRICULUM DEVELOPMENT PROCESS



## **Abbreviations Used**

<b>NCRC.</b>	National Curriculum Revision Committee
<b>VCC.</b>	Vice-Chancellor's Committee
<b>EXP.</b>	Experts
<b>COL.</b>	Colleges
<b>UNI.</b>	Universities
<b>PREP.</b>	Preparation

## INTRODUCTION

The Preliminary meeting of National Curriculum Revision Committee (NCRC) in the discipline of Mechatronics Engineering was held from October 19-21, 2015 at LEJ Centre, University of Karachi, under aegis of Higher Education Commission. The objective of meeting was to revise and prepare preliminary draft curriculum for BS/BE/BSc & MS/ME/MSc levels of Mechatronics Engineering. The following members attended the meeting:-

<b>Sr.</b>	<b>Name &amp; Address</b>	<b>Status</b>
1.	Dr. Akhtar Nawaz Malik, Director, Foundation University, Rawalpindi Campus.	<b>Member/Convener</b>
2.	Dr. Kunwar Faraz Ahmad Khan, HoD, Department of Mechatronics Engineering, NUST College of E & ME, Peshawar Road, Rawalpindi.	<b>Member/Secretary</b>
3.	Dr. Zareena Kausar, HoD, Department of Mechatronic Engineering, Air University B-Block Ground Floor Sector E-9, Islamabad.	<b>Member</b>
4.	Mr. Syed Riaz Akbar Shah, Professor, Department of Mechatronic Engineering, University of Engineering & Technology, B-5 Phase V, Hayatabad, University Campus, Peshawar.	<b>Member</b>
5.	Dr. Jawaid Daudpoto, Professor, Department of Mechanical Engineering, Mehran University of Engineering & Technology, Jamshoro.	<b>Member</b>
6.	DR. Faraz Junejo, HoD, Department of Mechatronics, Shaheed Zulfiqar Ali Bhutto Institute of Science & Technology, 90 & 100 Clifton, Karachi.	<b>Member</b>

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| 7.  | Dr. Ahmad Hussain,<br>Chairman / Professor,<br>Department of Mechanical Engineering,<br>Nazeer Hussain University,<br>ST-2, Block # 4, Federal B Area,<br>Karachi.  | <b>Member</b> |
| 8.  | Dr. Nasimullah,<br>Associate Professor,<br>Electrical Engineering.<br>City University of Science & Information<br>Technology, Dalazak Road, Peshawar.   | <b>Member</b> |
| 9.  | Dr. Sarvat Mushtaq Ahmad,<br>Associate Professor /Dean,<br>Faculty of Mechanical Engineering,<br>GIK Institute of Engineering Science &<br>Technology, Room # G03, FME, GIKI,<br>Topi, Distt, Swabi. KPK. | <b>Member</b> |
| 10. | Mr. Hashim Raza<br>Senior Director,<br>Nuclear Equipment Workshop-2,<br>Pakistan Atomic Energy Commission,<br>Plot # 3 & 4, Sector 22, Korangi<br>Industrial Area, Karachi.                               | <b>Member</b> |
| 11. | Dr. Abdur Rehman Abbassi,<br>Head (MS Program),<br>KINPOE (Affiliated with PIEAS)<br>Karachi.   | <b>Member</b> |
| 12. | Dr. Aamir Hassan,<br>Group Captain / Director,<br>Design Management Office,<br>Pakistan Aeronautical Complex,<br>PAC Board, Kamran Kalan, District<br>Attock.   | <b>Member</b> |
| 13. | Dr. Muzaffar Mehmood,<br>Associate Professor,<br>PAF-Karachi Institute of Economics &<br>Technology,<br>Main Campus, Korangi Creek,<br>Karachi 75190.   | <b>Member</b> |
| 14. | Dr. Amir Sultan,<br>Chairman,<br>Department of Mechatronics<br>Engineering, Chakwal campus,<br>University of Engineering and<br>Technology, Taxila.   | <b>Member</b> |



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| 15. | Dr. Ali Raza,<br>Assistant Professor,<br>Department of Mechatronics & Control<br>Engineering, University of Engineering &<br>Technology, Lahore.                                       | <b>Member</b> |
| 16. | Dr. Bilal Ahmed Siddiqui,<br>Assistant Professor,<br>Department of Mechanical Engineering,<br>DHA Suffa University, DG-78, Off<br>Khayaban-e-Tufail, Phase VII (EXT),<br>DHA, Karachi. | <b>Member</b> |
| 17. | Dr. Syed Naqvi,<br>Dean ,<br>Faculty of Computer Science,<br>Institute of Business and Technology,<br>Main Ibrahim Hydri Road, Korangi creek,<br>Karachi.                              | <b>Member</b> |

The meeting started with recitation of Verses from the Holy Quran by Mr. Riaz-ul-Haque, Assistant Director (Curriculum), HEC. Mr. Riaz-ul-Haque welcomed the participants on the behalf of HEC and thanked them for their participation in this important exercise.

The house unanimously selected Dr. Akhtar Nawaz Malik, Director, Foundation University, Rawalpindi as **Convener** and Dr. Kunwar Faraz Ahmad Khan, HoD, Department of Mechatronics Engineering, NUST College of Electrical & Mechanical Engineering, Rawalpindi as **Secretary** of the meeting. Mr. Haque then requested the respectable Convener & Secretary to convene proceedings of all technical sessions of the meeting for three days. The Convener thanked the participants for his selection and started proceedings of the meeting in accordance with the agenda.

### **Day 1**

The convener emphasized the need for periodic revision of curriculum in view of the fact that new techniques and methodologies are evolving the world over at a fast pace. Since the initial Curriculum for BSc/BS/BE/MS Mechatronics was developed in 2011, the goal of this meeting was to finalize that draft curriculum with consensus. The meeting started with identifying the weakness observed by industrial reps in mechatronics graduates when they step into practical life and the means addressing this weakness through an improved design of curriculum. Another point of emphasis was the integration and interlinking of courses in the mechanical, electrical, computing domain to form a cohesive curriculum and plan of study, instead of simply grouping together a few courses from each domain. In order to realize this concept, four groups were formed to look into the four major domains of subjects, i.e., Mechanical, Electronics,

Mechatronics and Basic Sciences/Humanities. The groups were asked to analyze and revise the contents of courses in their domain with special emphasis to identify duplication in content with different subjects, propose integration measures and present their conclusions on the next day. Subsequently, all courses in the curriculum were discussed individually and an initial draft of the revised curriculum was formulated.

### **Day 2**

On the day 2, the changes in the curriculum proposed in Day 1 were analyzed in detail and an exhaustive debate was carried out with input from the 4 groups regarding the courses within their domains. This resulted in the collective finalization of the course contents, allocation of credit hours, selection of text books, and elective courses. The elective courses were also discussed and it was proposed that in order to enable the formulations of streams at the undergraduate level the number of elective courses should be increased, which should be offered in the 3<sup>rd</sup> and 4<sup>th</sup> year. New courses were also proposed to be included as part of the core curriculum. The committee also focused on improving the social sciences domain of the curriculum and proposed an additional social science elective in the curriculum. At the end of the day, the BSc/BS/BE Mechatronics Curriculum was prepared and finalized for review of all members.

### **Day 3**

On the final day of the meeting the Final Draft of the curriculum for the Mechatronics Engineering was compiled and finalized gathering all the recommendations. The course content was also thoroughly discussed with a view to eliminate duplication with the course. After three days of rigorous deliberations, the committee unanimously proposed the outlines of draft curriculum of Mechatronics Engineering for undergraduate & graduate engineers, which will be considered in the final meeting of NCRC scheduled within three months' time.

The Committee, during the proceedings of the meeting, agreed that the draft curriculum will be sent to all members of the Committee, and if possible to expatriate Pakistani Mechatronics Engineers living abroad for further critical analysis and to submit their critical evaluation, suggestions, and recommendations, within **one month** to the Convener/ Secretary for onward submission to HEC.

Ms. Ghayur Fatima, Director Curriculum, HEC who joined the session latterly thanked the Convener and all the members of the committee for their high quality contribution towards preparation of the preliminary draft curriculum in the discipline of Mechatronics Engineering. The committee appreciated the efforts made by Mr. Riaz-ul-Haque & Ms. Ghayur Fatima for their coordination and guidance during the whole sessions and lauded the local hospitality provided by LEJ center.

The committee also proposed a couple of initiative to strengthen Mechatronics Engineering activity in Pakistan. This includes formation of Society of Mechatronics Engineers of Pakistan (SMEP) and a call for 1st Mechatronics Systems Engineering Conference (MSEC) Pakistan in summer 2017. In addition it was recommended that a few subjects for example Environment, Health and Safety should be covered through seminars/workshop instead of including them as part of the curriculum. All universities are requested to take steps for holding such seminars. The meeting ended with vote of thanks to and from the chair.

The final meeting of National Curriculum Revision Committee (NCRC) in the discipline of Mechatronics Engineering was held from March 7-9, 2016 at LEJ Centre, University of Karachi, to finalize the Curriculum for BSc/BS/BE Mechatronics Engineering. The following members attended the meeting:-

<b>Sr.</b>	<b>Name &amp; Address</b>	<b>Status</b>
1.	Dr. Akhtar Nawaz Malik, Director, Foundation University, Rawalpindi Campus.	<b>Member/Convener</b>
2.	Brig. Dr. Javaid Iqbal, Dean, Department of Mechatronics Engineering, NUST College of E & ME, Peshawar Road, Rawalpindi.	<b>Member/Secretary</b>
3.	Dr. Zareena Kausar, HoD, Department of Mechatronic Engineering, Air University B-Block Ground Floor Sector E-9, Islamabad.	<b>Member</b>
4.	Dr. Jawaid Daudpoto, Professor, Department of Mechanical Engineering, Mehran University of Engineering & Technology, Jamshoro.	<b>Member</b>
5.	DR. Faraz Junejo, HoD, Department of Mechatronics, Shaheed Zulfiqar Ali Bhutto Institute of Science & Technology, 90 & 100 Clifton, Karachi.	<b>Member</b>
6.	Dr. Ahmad Hussain, Chairman / Professor, Department of Mechanical Engineering,	<b>Member</b>

- Nazeer Hussain University,  
ST-2, Block # 4, Federal B Area,  
Karachi.
7. Engg. Dr. Nasimullah, **Member**  
Associate Professor,  
Electrical Engineering.
8. Dr. Sarvat Mushtaq Ahmad, **Member**  
Associate Professor /Dean,  
Faculty of Mechanical Engineering,  
GIK Institute of Engineering Science &  
Technology, Room # G03, FME, GIKI,  
Topi, Distt, Swabi. KPK.
9. Mr. Abid Chohan **Member**  
Director Production,  
Nuclear Equipment Workshop-2,  
Pakistan Atomic Energy Commission,  
Plot # 3 & 4, Sector 22, Korangi  
Industrial Area, Karachi.
10. Dr. Abdul Rehman Abbasi **Member**  
Head (MS Program),  
KINPOE (Affiliated with PIEAS)  
Karachi
11. Dr. Muzaffar Mehmood, **Member**  
Dean,  
PAF-Karachi Institute of Economics &  
Technology,  
Main Campus, Korangi Creek,  
Karachi 75190.
12. Dr. Adeel Mehmood, **Member**  
Assistant Professor,  
Department of Electrical Engineering,  
COMSATS Institute of Information  
Technology Islamabad.
13. Mr. Bilal Ahmed Siddiqui, **Member**  
Assistant Professor,  
Department of Mechanical Engineering,  
DHA Suffa University, DG-78, Off  
Khayaban-e-Tufail, Phase VII (EXT),  
DHA, Karachi.

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| 14. | Dr. Amir Sultan,<br>Chairman,<br>Department of Mechatronics<br>Engineering, Chakwal campus,<br>University of Engineering and<br>Technology, Taxila.        | <b>Member</b> |
| 15. | Dr. Syed Naqvi,<br>Dean ,<br>Faculty of Computer Science,<br>Institute of Business and Technology,<br>Main Ibrahim Hydri Road, Korangi<br>creek, Karachi . | <b>Member</b> |
| 16. | Ms. Ghayyur Fatima,<br>Director Academics Division,<br>Higher Education Commission, Is<br>lamabad  |               |

### Day 1

The meeting started with recitation of Verses from the Holy Quran by Dr. Sarvat Mushtaq Ahmad. Ms. Ghayyur Fatima, Director Academics Division, HEC welcomed the participants on the behalf of HEC and thanked them for their participation in this important exercise.

In the absence of Dr. Akhtar Nawaz Malik (Convener) due to flight delay, the house unanimously selected Brig. Dr. Javaid Iqbal, Dean, Department of Mechatronics Engineering, NUST College of E & ME, Peshawar Road, Rawalpindi as **Acting Convener** and Dr. Sarvat Mushtaq Ahmad, Dean, Faculty of Mechanical Engineering, GIK Institute of Engineering Science & Technology, Topi, Distt, Swabi as **Acting Secretary** of the meeting. Ms. Ghayyur Fatima then requested the respectable Convener & Secretary to convene proceedings of technical sessions. The Acting Convener thanked the participants for his selection and started proceedings of the meeting in accordance with the agenda.

Since the initial draft of the Curriculum for BSc/BS/BE Mechatronics was developed in an earlier meeting held between 19 -21 October 2015, the goal of this meeting was to finalize that draft curriculum with consensus. In this meeting, two groups were formed to look into the two major streams of Mechatronics, i.e., Mechanical and Electronics. The course contents developed by these groups were jointly discussed and unanimously approved. Furthermore, following additions were made to existing curricula for improvements.

- For clarity and uniformity FYP- HEC Course outline is written while taking into account Capston and NUST-FYP guidelines.

- Health and Safety education to be made mandatory through 1-2 days seminar/workshop for faculty, staff and students, preferably prior to commencement of BE studies.
- For complete coverage of PLOs, a Community Service Course (1-1) to be made mandatory. This course will consist of Seminars and field work. Field work can be carried out, such as working in Orphan House, old homes, Govt. School etc. This course will not contribute towards CGPA; however result (Satisfactory) will appear on transcript.

### **Day 2**

Dr. Akhtar Nawaz Malik (Convener) chaired the meeting on second day; an exhaustive debate was carried out collectively resulting in the finalization of the course contents, allocation of credit hours, selection of text books, and elective courses. At the end of the day, the final draft of the BSc/BS/BE Mechatronics Curriculum was prepared approved.

### **Day 3**

On third day; objective of the meeting was to finalize MS/MEng Mechatronics curricula. In this regard, a lengthy discussion was carried out, which resulted in the finalization of: different specializations, group of core and elective courses and selection of text books for MS/Meng Mechatronics Program. Furthermore, in continuation from last meeting, it was proposed to establish "Mechatronics Engineering Society Pakistan (MESP)" for promoting Mechatronics discipline in Pakistan. This society will aim to organize annual international conferences through collaboration of different Engineering Universities in Pakistan.

Ms. Ghayyur Fatima, Director Academics Division, HEC appreciated the Convener, Secretary and the members of the Committee for sparing their time for this noble cause.

The Meeting ended with the vote of thanks to the HEC, Convener, Secretary and members of National Curriculum Revision Committee.

## PhD MECHATRONICS ENGINEERING PROGRAMME

**Duration:** 6-8 years  
**Number of semesters:** 12-16  
**Number of weeks per semester:** 18 (16 for teaching and 2 for examinations)

**Total number of credit hours:** 18  
**Number of credit hours per semester:** 6-12  
**Courses are selected as per GEC**  
**Recommendation relevant to student's research:** 100 %

### 1. PhD Courses

#### a) Elective Courses (as per GEC Recommendations)

MTS-	All MS level courses	03
MTS-	Micro and Nano Fabrication	03
MTS-	Photonic Devices	03
MTS-	Nano-Electronics	03
MTS-XXX	Advanced Robotics	03
MTS-	Detection and Estimation	03
MTS-	Non-Linear Control Systems	03
MTS-	Advanced Topics in Control Systems	03
MTS-	Advances in Manufacturing Technologies	03
MTS-	Rapid Prototyping and Manufacturing	03
MTS-	Advanced Information Systems for	03
MTS-XXX	Image and Vision Computing in Medicine	03
MTS-XXX	Advanced Bio-signal Processing	03
MTS-XXX	Advances in Biomedical Materials	03
MTS-XXX	BioNanotechnology	03
MTS-XXX	Microfluidics and BioMEMS	03
MTS-XXX	Robotic Manipulation	03
MTS-XXX	Robot Motion Planning	03
MTS-	Special Topics for PhD program (Robotics)	03
MTS-	Special Topics for PhD program	03
MTS-	Special Topics for PhD program (Artificial	03
MTS-	Special Topics for PhD program(Machine	03

MTS-	Special Topics for PhD program (Control	03
MTS-	Or any other relevant course (s)	03

**b) PhD Dissertation**

MTS-	Dissertation	30-0
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## SCHEME OF STUDIES FOR PhD IN MECHATRONICS

### Semester 1

S. No.	Subject Code	Subject Name	Credit Hours (Cr Hrs)	Total Cr Hrs
1	MTS-XXX	Course 1	3-0	6
2	MTS-XXX	Course 2	3-0	

### Semester 2

S. No.	Subject Code	Subject Name	Credit Hours (Cr Hrs)	Total Cr Hrs
1	MTS-XXX	Course 3	3-0	6
2	MTS-XXX	Course 4	3-0	

### Semester 3

S. No.	Subject Code	Subject Name	Credit Hours (Cr Hrs)	Total Cr Hrs
1	MTS-XXX	Course5	3-0	6
2	MTS-XXX	Course6	3-0	

### Semester 4 & onward (Thesis Research)

S. No.	Subject Code	Subject Name	Credit Hours (Cr Hrs)	Total Cr Hrs
1	MTS-XXX	Dissertation	30-0	30