CURRICULUM

OF

MECHATRONICS ENGINEERING

FOR

4-YEARS BS/BSc/BE PROGRAMME

HIGHER EDUCATION COMMISSION
ISLAMABAD – PAKISTAN

CURRICULUM DIVISION, HEC

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PREFACE

The curriculum of subject is described as a throbbing pulse of a nation. By viewing curriculum one can judge the stage of development and its pace of socio-economic development of a nation. With the advent of new technology, the world has turned into a global village. In view of tremendous research taking place world over new ideas and information pours in like of a stream of fresh water, making it imperative to update the curricula after regular intervals, for introducing latest development and innovation in the relevant field of knowledge.

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

In compliance with the above provisions, the HEC undertakes revamping and refurbishing of curricula after regular intervals in a democratic manner involving universities/DAIs, research and development institutions and local Chamber of Commerce and Industry. The intellectual inputs by expatriate Pakistanis working in universities and R&D institutions of technically advanced countries are also invited to contribute and their views are incorporated where considered appropriate by the National Curriculum Revision Committee (NCRC).

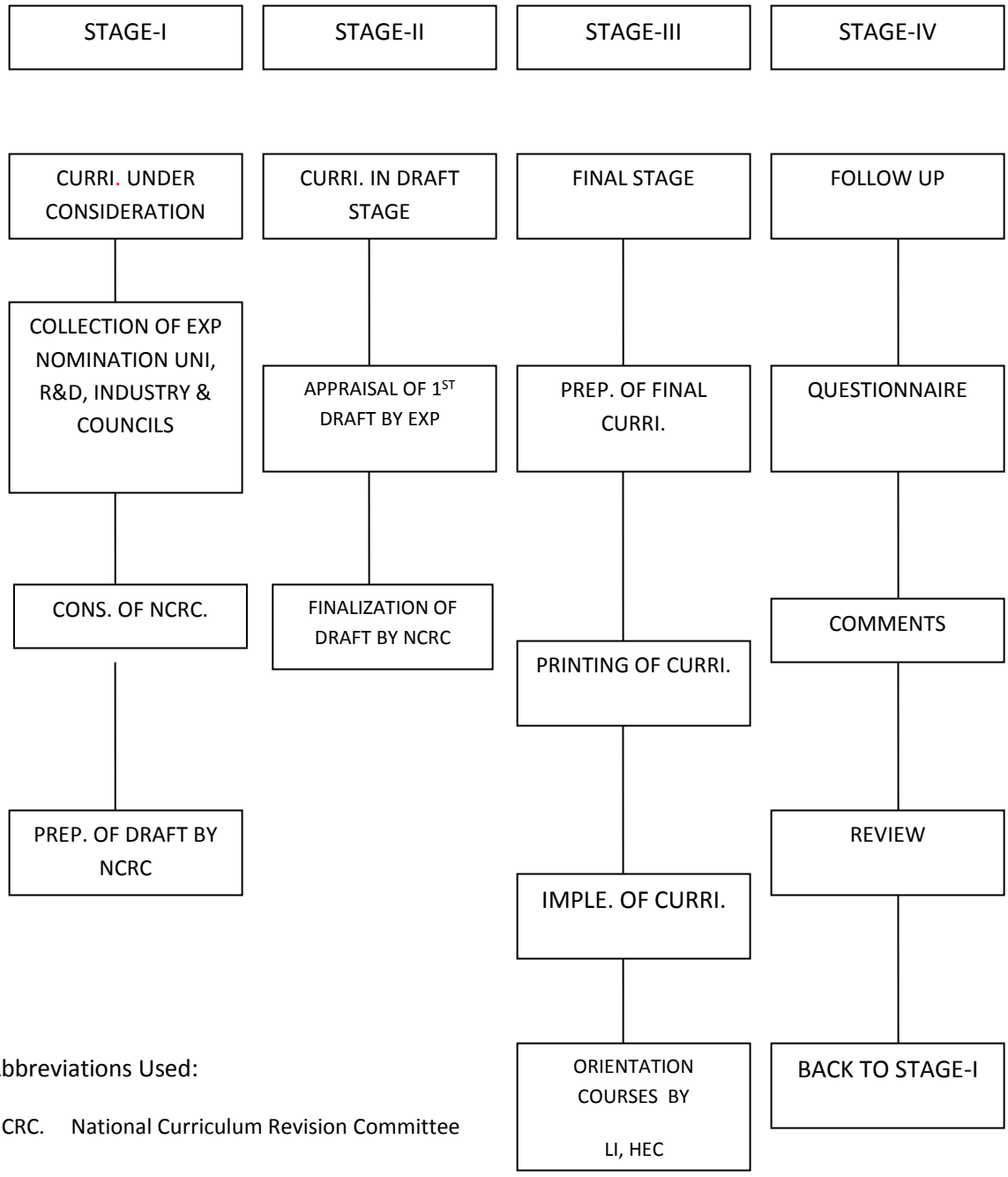
To bring international compatibility to qualifications held from Pakistani universities/DAIs for promotion of students mobility and job seekers around the globe, a Committee comprising of Conveners of the National Curriculum Revision Committee of HEC met in 2009 and developed a unified template for standardized 4-years/8-semesters BS degree programmes. This unified template was aimed to inculcate broader base of knowledge in the subjects like English, Sociology, Philosophy, Economics etc in addition to major discipline of study. The Bachelor (BS) degree course requires to be completed in 4-years/8-semesters, and shall require qualifying of 130-140 credit hours of which 77% of the curriculum will constitute discipline specific and remaining 23% will comprise compulsory and general courses.

In line with above, NCRC comprising senior university faculty and experts from various stakeholders and the respective accreditation councils has finalized the curriculum for BS 4-year BS/BSc/BE in Mechatronics Engineering. The same is being recommended for adoption by the universities/DAIs channelizing through relevant statutory bodies of the universities.

MUHAMMAD JAVED KHAN
Adviser Academics

June, 2011

CURRICULUM DEVELOPMENT



Abbreviations Used:

NCRC. National Curriculum Revision Committee

VCC. Vice-Chancellor's Committee

EXP. Experts

COL. Colleges

UNI. Universities

PREP. Preparation

INTRODUCTION

Preliminary meeting of National Curriculum Revision Committee (NCRC) to prepare the Curriculum for Mechatronics Engineering was held at HEC Regional Centre, Lahore from 06-08 December, 2010. The following participants attended the meeting:-

1.	**Brig. Dr. Akhtar Nawaz Malik,** Professor, Dean, College of E&ME, Rawalpindi, National University of Sciences & Technology, H-12, Islamabad	Convener
2.	**Engr. Dr. Shaiq A. Haq,** Professor, Dean Faculty of Engineering, WEC, University of Wah, Wah Cantt:	Secretary
3.	**Mr. Liaquat Ali Khan,** Assistant Professor Department of Mechatronics Engineering Air University, Islamabad	Member
4.	**Engr. Aamir Hasan Khan,** Assistant Professor, Department of Electronic Engineering, PAF-KIET, PAF Base Korangi Creek, Karachi	Member
5.	**Brig. Dr. Javaid Iqbal,** Professor, Head of Department of Mechatronics, College of E&ME, Rawalpindi, National University of Sciences & Technology, H-12, Islamabad	Member
6.	**Dr. Asif Israr,** Assistant Professor, Department of Aeronautics and Astronautics, Institute of Space Technology, Islamabad	Member

7.	**Dr. Syed Raiz Akbar Shah,** Director, Institute of Mechatronics Engineering, University of Engineering and Technology, Peshawar	Member
8.	**Dr. Izhar ul-Haq,** Assistant Professor, Institute of Mechatronics Engineering, University of Engineering and Technology, Peshawar	Member
9.	**Engr. Dr. M. Pervaiz Mughal,** Professor, Department of Industrial & Manufacturing Engineering, University of Engineering and Technology, Lahore	Member
10.	**Dr. Aslam Pervez,** Principal Engineer, Department of Instrumentation Control & Computer Complex, Pakistan Atomic Energy Commission, Islamabad	Member
11.	**Dr. Abdul Rauf,** Principal Engineer, Department of Instrumentation Control & Computer Complex, Pakistan Atomic Energy Commission, Islamabad	Member

The meeting started with recitation from the Holy Quran by Prof. Dr. Javaid Iqbal. Prof. Dr. Altaf Ali G. Sheikh, Member Academics, HEC welcomed the participants and informed the members of the committee about procedure for review and revision. He emphasized the need for periodic revision of curriculum in view of the fact that a lot of knowledge, new techniques and methodologies are evolving the world over dictating the professionals to keep pace with time and adopt these changes for the need of future technological developments. He requested the committee to appoint its convener and the secretary to conduct and record the proceedings.

The committee unanimously appointed Prof. Dr Akhtar Nawaz Malik, Dean EME, NUST, Rawalpindi, as Convener and Prof. Dr. Shaiq A. Haq, Dean, Faculty of Engineering, University of Wah, as Secretary respectively. The

Convener and the Secretary thanked the members for reposing confidence and assure them of their fullest cooperation and intellectual inputs during the course of proceedings.

The Chair clarified further issues for the Group, the experts in the various specialties were identified and lacunae were identified, it was requested by the chair to invite further membership in these areas from the local institutions in Lahore.

Since the exercise for preparation of the draft curriculum of Mechatronics is done for the very first time at national level to set minimum criteria for the award of degrees in this field; it was decided with the approval of Convener to openly brainstorm about the possible combinations of courses that can become part of the curriculum.

During the two technical sessions the committee drafted the comprehensive list of Non-Engineering and Engineering domain courses for further detailed discussion.

Day 2

On the day 2 an exhaustive debate was held resulting in selection of the course contents in detail, allocation of credit hours and selection of text books. Finally courses were distributed semester wise.

Day 3

On the final day of the meeting the initial draft for the undergraduate and post graduate curriculum for the Mechatronics Engineering was compiled and finalized for experts review.

Dr. Tahir Ali Shah, Deputy Director Curriculum HEC, Islamabad thanked the Convener, Secretary and the member of the Committee for sparing their time and lot of professional contribution towards preparation of preliminary draft curriculum for Mechatronics Engineering.

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

Final meeting of National Curriculum Revision Committee (NCRC) was held at HEC Regional Centre, Lahore from 04-06 April, 2011 to finalize the Curriculum for BSc/BS/BE Mechatronics Engineering. To build consensus on the curriculum, HEC had invited leading professionals from all over Pakistan.

The following participants attended the meeting:-

1. **Brig. Dr. Akhtar Nawaz Malik,** — Convener
   Professor,
   Dean, College of E&ME, Rawalpindi,
   National University of Science & Technology,
   H-12, Islamabad

2. **Mr. Liaquat Ali Khan** — Member
   Assistant Professor
   Department of Mechatronics Engineering
   Air University,
   Islamabad

3. **Engr. Aamir Hasan Khan,** — Member
   Assistant Professor,
   Department of Electronic Engineering,
   PAF-KIET, PAF Base Korangi Creek,
   Karachi

4. **Brig. Dr. Javaid Iqbal,** — Member
   Professor,
   Head of Department of Mechatronics,
   College of E&ME, Rawalpindi,
   National University of Sciences & Technology,
   H-12, Islamabad

5. **Dr. Asif Israr,** — Member
   Assistant Professor,
   Department of Aerospace Engineering,
   Institute of Space Technology,
   Islamabad

6. **Dr. Syed Raiz Akbar Shah,** — Member
   Director,
   Institute of Mechatronics Engineering,
   University of Engineering and Technology,
   Peshawar

7. **Dr. Izhar ul-Haq,** — Member
   Assistant Professor,
   Institute of Mechatronics Engineering,
   University of Engineering and Technology,
   Peshawar

8. **Dr. Aslam Pervez,** — Member
Principal Engineer,
Department of Instrumentation Control &
Computer Complex,
Pakistan Atomic Energy Commission,
Islamabad

9. **Dr. Abdul Rauf,** — Member
Principal Engineer,
Department of Instrumentation Control &
Computer Complex,
Pakistan Atomic Energy Commission,
Islamabad

10. **Dr. Khalid Munawar,** — Member
Professor,
Department of Electrical Engineering,
College of E&ME, Rawalpindi,
National University of Sciences & Technology,
H-12, Islamabad

11. **Dr. Muhammad Ejaz Sandhu** — Member
Professor,
CEO, BITBRICKS,
70 C/I MM Alam Road,
Lahore

12 **Dr. Jamal Tariq Mian,** — Member
Professor
Department of MCED,
University of Engineering & Technology,
Lahore

13. **Engr. Dr. Shaiq A. Haq,** — Secretary
Professor,
Dean Faculty of Engineering,
WEC, University of Wah,
Wah Cantt:

Day 1

The meeting started with recitation from the Holy Quran by Dr. Izhar-ul-Haq. Mr. M. Javed Khan, Adviser Academics HEC, welcomed the participants and informed the members of the committee about the procedure for review and revision. Along with the development of curriculum for this new engineering discipline he also 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 draft of the Curriculum for BSc/BS/BE Mechatronics was developed in an earlier meeting held on 6-8th December 2010, 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.

Day 2

On the day 2, 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 and softcopies were dispatched to all the committee members for final approval.

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.

Dr. Tahir Ali Shah, Dy. Director Curriculum, HEC thanked the Convener, Secretary and the members of the Committee for sparing their time and making this noble contribution towards preparation of curriculum for Mechatronics Engineering to be followed by all the engineering universities of Pakistan

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

CURRICULUM FOR MECHATRONICS ENGINEERING

Mechatronics Programme – Educational Objectives

To achieve educational mission, our programme has a set of educational objectives:

1. To enable the graduates to understand the interdisciplinary fundamentals of mechanical engineering, electrical engineering, control systems, computer engineering and their integration.
2. To enable the graduates to successfully identify problems, design and optimize integrated solutions by focusing on modern Mechatronics engineering practices.
3. To enable the graduates to innovate, develop and adopt new directions in their advance education.
4. To nurture strong team skills among the graduates in order to enable them to communicate and work effectively while solving complex problems in a multidisciplinary environment.

Mechatronics Programme – Outcomes

Mechatronics Engineering graduates must:

1. Have an ability to apply knowledge of mathematics, science and engineering.
2. Have familiarization with current technology and how it can be incorporated into their design, analysis, and testing activities including an understanding of manufacturing methods and the use of computers, sensors, and actuators to automate machines and processes.
3. Have enough hands-on experience and have an ability to use modern engineering tools to enhance their productivity.
4. Have an ability to design a holistic Mechatronics system, components, or processes to meet desired objectives.
5. Have an ability to focus on creative learning techniques, develop and evaluate alternate solutions to real world problems.
6. Have an understanding of professional ethical responsibility.
7. Have an ability to communicate technical matters effectively in oral, written or in graphical form.

STANDARD TEMPLATE FOR
BS/BSc/BE MECHATRONICS ENGINEERING PROGRAMME

Duration:	4 years
Number of semesters:	8
Number of weeks per semester:	16-18 (16 for teaching and 2 for examinations)
Total number of credit hours:	130-140
Number of credit hours per semester:	15-20
Engineering Courses (Minimum):	65-70 %
Non-Engineering Courses (Maximum):	30-35 %

Non-Engineering Domain

Knowledge Area	Sub Area	Name of Course	Lec CH	Lab CH	Cr. Hr	Total Courses	Total Credits	% Area	% Overall
Humanities	English	Communication Skill	2	1	3	2	6	15.38	4.32
		Technical Report Writing	3	0	3				
	Culture	Islamic Studies	2	0	2	2	4	10.26	2.88
		Pakistan Studies	2	0	2				
	Social Sciences	Social Sciences Elective	2	0	2	1	2	5.13	1.44
Management Sciences		Engineering Economics	3	0	3	2	6	15.38	4.32
		Management Sciences Elective	3	0	3				
Basic Sciences	Math	Calculus and Analytic Geometry	3	0	3	6	18	46.15	12.95
		ODEs and Linear Algebra	3	0	3				
		Vector Calculus	3	0	3				
		Probability and Statistics	3	0	3				
		Complex Variables and Transforms	3	0	3				
		Numerical Methods	2	1	3				
	Physics	Applied Physics	3	0	3	1	3	7.69	2.16
Total			37	2	39	14	39	100.00	28.06

LecCH: Lecture Credit Hours, LabCH: Laboratory Credit Hours

Engineering Domain

Knowledge Area	Sub Area	Name of Course	Lec CH	Lab CH	Cr. Hr.	Total Courses	Total Credits	% Area	% Overall
Computing	Fundamentals	Computer Programming	2	1	3	3	9	9.09	6.47
	Programming	Data Structures and Object Oriented Programming	2	1	3				
	Design	Digital Logic Design	2	1	3				
Engineering Foundation	--	Workshop Practice	0	2	2	11	33	33.00	23.74
		Engineering Drawing	0	2	2				
		Engineering Statics	3	0	3				
		Engineering Dynamics	3	0	3				
		Mechanics of Materials	2	1	3				
		Materials and Manufacturing Processes	3	0	3				
		Theory of Machines	2	1	3				
		Thermodynamics	2	1	3				
		Electric Circuits	2	1	3				
		Electronics Devices and Circuits	3	1	4				
		Electromechanical Systems	3	1	4				
Major Based Core (Breadth)	--	Fluid Mechanics, Hydraulics and Pneumatics	3	1	4	7	26	26.00	18.71
		Heat transfer	2	1	3				
		Network Analysis	2	1	3				
		Electronic Circuits	3	1	4				
		Microcontroller Based Design	2	2	4				
		Transducers and Instrumentation	3	1	4				
		Control Systems	3	1	4				
Major Based Core (Depth)	--	Design of Machine Elements and CAD/CAM	2	1	3	8	26	26.00	18.71
		Mechanical Vibration	2	0	2				
		Power Electronics	3	1	4				
		Industrial Automation	2	1	3				
		Mechatronics System Design	2	2	4				
		Robotics	3	1	4				
		Engineering Elective I	3	0	3				
		Engineering Elective II	3	0	3				

Senior Design Project	--	Senior Design Project	0	3	3	2	6	6.00	4.32
		Senior Design Project	0	3	3				
Industrial Training (Summer)			0	0	0	0	0	0	0
Total			67	33	100	31	100	100.00	71.95

ELECTIVES:
Social Sciences Elective

1. Professional Ethics
2. Sociology and Development
3. Organizational Behaviour
4. Introduction to Philosophy
5. Or any other relevant course (s)

Management Sciences Elective

1. Engineering Management
2. Total Quality Management (TQM)
3. Entrepreneurship, Leadership and Team Management
4. Principles of Management
5. Research Methodology
6. Or any other relevant course (s)

Engineering Electives

1. Modeling and Simulation
2. Filter Design and Digital Signal Processing
3. Digital Image Processing
4. Artificial Intelligence and Computer Vision
5. Computer Aided Engineering
6. Embedded Systems
7. Digital Control
8. Advanced Control Systems
9. Power Plants
10. Special Topics in Mechatronics
11. Precision Manufacturing
12. Energy resources and management
13. Fuzzy Logic
14. Neural Network
15. Or any other relevant course(s)

BS/BSc/BE MECHATRONICS

ENGINEERING PROGRAMME

Summary

Domain	Knowledge Area	Total Courses	Total Credits	% Overall
Non-Engineering	Humanities	5	12	29
	Management Sciences	2	6	
	Natural Sciences	7	22	
	Sub Total	14	40	
Engineering	Computing	3	9	71
	Engineering Foundation	7	20	
	Major Based Core (Breadth)	7	25	
	Major Based Core (Depth)	11	39	
	Senior Design Project	2	6	
	Industrial Training (Summer)	0	0	
	Sub Total	30	99	
	Total	**44**	**139**	**100**

SCHEME OF STUDIES FOR BS/BSc/BE IN MECHATRONICS

Semester 1		
GS-1xx	Calculus and Analytic Geometry	3+0
HS-1xx	Communication Skills	2+1
GS-1xx	Applied Physics	3+0
ME-1xx	Workshop Practice	0+2
EE-1xx	Electric Circuits	2+1
HS-1xx	Islamic Studies	2+0
	Total	12+4
	Semester Total	**16**
	Cumulative credits	**16**

Semester 2		
GS-1xx	ODEs & Linear Algebra	3+0
ME-1xx	Engineering Statics	3+0
ME-1xx	Engineering Drawing	0+2
CS-1xx	Computer Programing	2+1
HS-1xx	Technical Report Writing	3+0
HS-1xx	Pakistan Studies	2+0
EE-1xx	Network Analysis	2+1
	Total	15+4
	Semester Total	**19**
	Cumulative credits	**35**

Semester 3		
GS-2xx	Vector Calculus	3+0
EE-2xx	Electronics Devices and Circuits	3+1
ME-2xx	Engineering Dynamics	3+0
ME-2xx	Materials and Manufacturing Processes	3+0
CS-2xx	Data Structures and Object Oriented Programing	2+1
CS-2xx	Digital Logic Design	2+1
	Total	16+3
	Semester Total	**19**
	Cumulative credits	**54**

Semester 4		
GS-2xx	Complex Variables and Transforms	3+0
EE-2xx	Electronic Circuits Design	3+1
HS-2xx	Social Sciences Electives	2+0
ME-2xx	Mechanics of Materials	2+1
ME-2xx	Thermodynamics	2+1
MTE-2xx	Electromechanical Systems	3+1
	Total	15+4
	Semester Total	**19**
	Cumulative credits	**73**

Semester 5		
GS-3xx	Numerical Methods	2+1
MTE-3xx	Microcontroller Based Design	2+2
ME-3xx	Theory of Machines	2+1
ME-3xx	Fluid Mechanics, Hydraulics and Pneumatics	3+1
MTE-3xx	Transducers and Instrumentation	3+1
MTE-3xx	Mechanical Vibrations	2+0
	Total	14+6
	Semester Total	**20**
	Cumulative credits	**93**

Semester 6		
GS-3xx	Probability and Statistics	3+0
MTE-3xx	Control Systems	3+1
MTE-3xx	MechatronicS Systems Design	2+2
MTE-3xx	Design of Machine Elements and CAD/CAM	2+1
MTE-3xx	Power Electronics	3+1
MS -3xx	Engineering Economics	3+0
	Total	16+5
	Semester Total	**21**
	Cumulative credits	**114**

Semester 7		
MTE-4xx	Robotics	3+1
MTE-4xx	Industrial Automation	2+1
MTE-4xx	Engineering Elective I	3+0
MS-4xx	Management Sciences Elective	3+0
MTE-4xx	Senior Design Project	0+3
	Total	11+5
	Semester Total	**16**
	Cumulative credits	**130**

Semester 8		
MTE-4xx	Heat Transfer	2+1
MTE-4xx	Engineering Elective II	3+0
MTE-4xx	Senior Design Project	0+3
	Total	5+4
	Semester Total	**9**
	Cumulative credits	**139**

DETAIL OF COURSES
CONTENTS AND TEXT BOOKS
B.E. MECHATRONICS ENGINEERING

HS-1xx COMMUNICATION SKILLS

Theory Cr Hrs, 2
Lab Cr Hrs, 1

Course Objectives:
The objective of this course is to train the students about the art of oral and written communication. A special emphasis is given to the improvement of fluency and accuracy in the use of English language.

Topics Covered:
Structure of English Language**,** Phonetics, Syntax, Basic Common Errors, Rhetoric and Eloquence, Figures of Speech, Reading/Study Skills, Writing Process, Technical Writing, Effective Communication.

Recommended Books:
1. Read Better, Write better Reader's Digest Compilation, Latest Edition.
2. Technical Writing, and Specifications; Gliden H.K, Reports, London, McGraw-Hill Book Company, Latest Edition.

HS-1xx TECHNICAL REPORT WRITING

Theory Cr Hrs, 3
Lab Cr Hrs, 0

Course Objectives:
This course equip students with writing skills as may form useful foundation to respond with proficiency, to job-seeking situations, initial office correspondence/tasks or to pursue higher education/research at Postgraduate level.

Topics Covered:
Technical Writing, Research Writing, Letter Writing, Personal Letters, Business Writing, Practice.

Recommended Books:
1. Reports, Technical Writing and Specifications by Glidon H.K, Mcgraw Hill Book Company, London, Latest Edition.
2. Technical Writing by Steve M. Gerson, Latest Edition.
3. Reporting Technical Information by Kenneth W. Houp, Thomas E. Pearsall, Tebeaux and Dragga, Latest Edition.

4. Technical Communication by Rebecca E. Burnett, Latest Edition.

HS-1xx ISLAMIC STUDIES

Theory Cr Hrs, 2
Lab Cr Hrs, 0

Course Objectives:
The course aims to build up the character of the students and intends to cover the fundamentals of Islam.

Topics Covered:
Subjective Study of the Holy Quran and Hadith, The meaning of Islam, Ibadaat (Worship), Amr Bil Maroof wa Nahi anl Munkir (Commands and Prohibition), Unity of Ummah, Kasb-I-Halal (Lawful Earning), Fundamental Human Rights: Holy Prophet As a Model of excellence, Islamic Civilization.

Recommended Books:
1. Islamic Education by A. S. Bukhari & M. D Zafar, Latest Edition.
2. Muslim's character by M. Al-Ghazali, Latest Edition.
3. Lecture Note.

HS-1xx PAKISTAN STUDIES

Theory Cr Hrs, 2
Lab Cr Hrs, 0

Course Objectives:
To promote patriotism in Pakistani youth as its objectives, and also provide students with an understanding of the interactive internal and external forces and their impact in shaping the political economic, technological and social developments in Pakistan.

Topics Covered:
Genesis of Pakistan, History of Subcontinent, War of Independence, British Rule, Pakistan Movement, Development of Political & Constitutional System, Man, Society and State, Need of political system, Elements of State & Organs of Government in Pakistan since independence, Political systems experienced so far, Economic Development in Pakistan, Pakistan in the Comity of Nations, The Geo-strategic importance, Need to redefine the goals and discretions of Pakistan's Foreign policy, War against terrorism, Pak India Relations (Confidence building measures), Social & Environmental Problems in Pakistan, Poverty, Unemployment, Gender discrimination, Corruption, Water Reservoirs and Dams, Human Rights Issues , Conceptual foundations

of Human Rights, The UN's system of protection of Human Rights, Pakistan's response to Human, Rights at National & International level.

Recommended Books:

1. The Emergence of Pakistan by Chaudhry Muhammad Ali, Latest Edition.
2. Pakistan's Foreign Policy: A Reappraisal by Shahid Amin Mahmood, Latest Edition.
3. Human Rights Pakistan Studies Compulsory, HEC, Islamabad, Latest Edition.

HS-2xx PROFESSIONAL ETHICS

Theory Cr Hrs, 2
Lab Cr Hrs, 0

Course Objectives:

The aim of this course is to examine the role and purpose of professional ethics. To present methods of moral reasoning, case analysis, and of resolving ethical dilemmas. To present Islamic values considered especially relevant to business activity.

Topics Covered:

Introduction to Definitions/Importance/Kinds, Factors/Sources of Islamic Ethics, Moral Theories of Ethics about Major Ethical theories/Islamic Principles of Ethics, Islam VS Major ethical theories, Islamic ethical system, Axioms of Islamic ethical Philosophy, Ethics in Business, Enforcement of ethical environment/Factors

Principles & Decision Making, Islamic rules for business, Lawful and unlawful behaviour in Islam, Halal and Harram business/Islamic principles, Engineering Ethics, Scope & Aims, Theories, responsibilities, IEEE code of Ethics, Ethical code for engineer, Ethical code for Software engineers, Moral Courage, Moral courage, its importance and how to improve Attributes of morally courageous.

Recommended Books:

1. Engineering Ethics, Concepts & Cases by C. Harris Words Worth, 1994, Islamic Education, Latest Edition.
2. Ethics Engineering (Latest Edition) – Mike W. Martin.
3. Lecture Notes.
4. Business Ethics (A stake Holder & Issues Management Approach) Latest Edition by Joseph W. Weiss, Contemporary Moral Issues by Lawrence M. Prentice.

MS-2xx ENGINEERING ECONOMICS

Theory Cr Hrs, 2
Lab Cr Hrs, 0

Course Objectives:

This course deals with the thought processes, concepts, methods, and knowledge bases used by engineers to cost engineering projects and to evaluate the merit of making a particular investment and to choose the best of a series of alternative investments to achieve a desired objective.

The theory of microeconomics makes use of the tools of marginal cost-benefit analysis to provide a framework for the economic analysis of decision-making. The focus is on the choices of individual firms and consumers, and the resultant outcomes in individual markets. The social implications of the functioning of competitive markets are examined, as well as the causes of market failure and the potential roles of government in correcting them.

At the end of this course, the student would have clear understanding of cost concepts, money time relationship, break-even analysis, benefit-cost analysis and depreciation.

Topics Covered:

Introduction: Definition, decision-making process, relationship between engineering and management, and principles of engineering economy. Cost concepts and analysis: terminology, application of cost concepts, and accounting and engineering economy studies. Money-time relationship: Time value of money, simple and compound interest, cash flow, single sums of money, uniform series of cash flows and equivalence. Basic methods: present worth, annual worth, future worth, internal rate of return, and external rate of return methods. Comparing alternative proposals: Present worth, Annual payments, future worth, and rate of return methods. Break-even analysis: break-even point, break-even involving income and cost analysis. Benefit-cost analysis: Comparing benefits of costs, B/C ratios, and methods for calculating B/C ratios. Depreciation: measuring depreciation, depreciation accounting and standard methods for calculating depreciation.

Recommended Books:

1. Engineering Economy by DcGarmo, E. P., Sullivan G. W. and Bontadelli, A. J., Macmillan publishing company, Latest Edition.
2. Engineering Economic and Cost Analysis by Collier, A. C. and Ledbetter B. W., Harper and Row Publishers, New York, Latest Edition.
3. Principles of Engineering Economic Analysis, by White, A. J, Agee H. M. And Case, E. K, John Wiley and Sons, Latest Edition.

MS-4xx ENGINEERING MANAGEMENT

Theory Cr Hrs, 3
Lab Cr Hrs, 0

Course Objectives:

Engineering Management is a specialized form of management that is required to successfully lead engineering or technical personnel and projects. The term can be used to describe either functional management or project management.

Engineering managers typically require training and experience in both general management and the specific engineering disciplines that will be used by the engineering team to be managed.

The successful engineering manager must have the skills necessary to coach, mentor and motivate technical professionals, which are often very different from those that are required for individuals in other fields.

Topics Covered:

Concept of a project and its definition, Introduction to planning, scheduling and control of projects, Network model and its applications. Probabilistic and Deterministic Approaches. Gantt charts, PERT and CPM. Network simulation, latest software on project management, Determination of resources requirements of a project, Work Breakdown Structure (WBS), Request for Proposal (RFP), Resource leveling, Project scheduling under limited resources. Project crashing and alternatives analysis. Case studies and Problem Solution.

Recommended Books:

1. Production and Operations Management by Alan Muhlemann, John Oakland and Keith Lockyer 1995 Reprint, Sixth Edition, Pitman Publishing, London.
2. Engineering Economy by E. Paul DeGarmo, William G. Sullivan and John R. Canada 1984, Sixth Edition, Macmillan Publishing Company, New York/London.

GS-1xx CALCULUS AND ANALYTICAL GEOMETRY

Theory Cr Hrs, 3
Lab Cr Hrs, 0

Course Objectives:

This course advances conceptual and technical competencies in analytical geometry and calculus. On successful completion of this course students

should be able to effectively communicate the mathematical concepts, reasoning and technical skills contained in this course.

Topics Covered:

Vectors, Scalars and Vector products, Definitions of limits & continuity, techniques of finding limits, Definitions of limits & continuity, techniques of finding limits, Techniques of differentiation, tangent lines and rates of change, Extreme functions, Rolle's and Mean value theorems, concavity and optimization problems, Techniques of indefinite integration, Definite integrals, properties of definite integrals, Solids of revolution, volume of solids of revolution, Arc length, surface of revolution, centre of mass, Integration of transcendental functions, Indeterminate forms and L'Hopital's rule, Integrals of trigonometric and rational functions, improper integrals, Convergence and divergence of sequences and series, positive terms series, integral test, p-series, Basic comparison test, limit comparison test, the ratio and root tests, alternating series, absolute and conditional convergence, Power series, Maclaurin series, Taylor series and their applications.

Recommended Books:

1. Calculus (Latest Edition) by Swokowski, Onlinick & Pence.
2. Calculus and Analytical Geometry (Latest Edition) by G.B. Thomas & R. L Finney.
3. Essentials of Mathematics by M. Rafique.

GS-1xx ORDINARY DIFFERENTIAL EQUATIONS AND LINEAR ALGEBRA

Theory Cr Hrs, 3
Lab Cr Hrs, 0

Course Objectives:

The course will cover concept of linear systems of ordinary differential equations and Laplace transform methods. At the end, the students should be able to apply the fundamentals and applications of Ordinary Differential equations and Linear Algebra concepts.

Topics Covered:

Introduction to Differential Equations, ODE of First order and first degree, ODEs of second and higher orders. Non-homogeneous linear differential equations, Systems of linear differential equations. Introduction to matrices, Algebra of matrices, Special matrices, Determinants and their properties, Linear independence, bases, Vector space, System of linear equation, Gauss elimination, Eigenvalues, Eigenvectors.

Recommended Books:

1. Advanced Engineering Mathematics (Latest Edition) by E. Kreyszig.
2. Ordinary Differential Equations and BVPs by M. Rafique, Latest Edition.
3. Modern Engineering Mathematics by Glyn James, Latest Edition.

GS-2xx VECTOR CALCULUS

Theory Cr Hrs, 3
Lab Cr Hrs, 0

Course Objectives:

This course focuses on understanding the concepts of vectors, functions of more than one variable, partial differentiation, and multiple integrals. Applications to geometry and physics, as well as other real- life problems are particularly emphasized in the course.

Topics Covered:

Analytical Geometry in 3-space, Cylindrical and Spherical cords, Surfaces, Vector & Scalar functions and fields, Curves, Tangents, Arc length of a curve, Velocity, Acceleration, Curvature & Torsion of a curve, Gradient of a Scalar Field and directional derivatives, Divergence of a Vector Field, Curl of a Vector Field, Gradient, Divergence and Curl in Curvilinear coordinates, Line integral, integration around closed curves, Application of double integrals, Green's theorem, Tangent planes, Surface normal, Surface integrals, Triple integrals, Divergence theorem of Gauss, Application of the Divergence theorem, modeling of heat flow, Stokes's theorem.

Recommended Books:

1. Advanced Engineering Mathematics (Latest Edition) by E. Kreyszig.
2. Vector and Tensor Analysis with Applications by Borisenko & Taranov, Latest Edition.

GS-2xx TRANSFORMS AND COMPLEX ANALYSIS

Theory Cr Hrs, 3
Lab Cr Hrs, 0

Course Objectives:

This course covers complex variable analysis and Fourier analysis. After successfully completion of the course, the students should be able to calculate and manipulate several important transforms and to apply these transforms to linear systems, wave propagation, and signal analysis.

Topics Covered:

Complex numbers: Basic concepts, Polar Form, Euler Formula, Limit, continuity and Differentiability of Complex functions, Fourier series for functions of any period, Even and Odd functions, Half range expansions, Complex Fourier series, Fourier integral, Fourier Cosine and Sine Transforms, Fourier Transform of the Derivatives, Convolution, Partial differential equations solvable as ODEs, Modeling a Vibrating String, Derivation of Wave Equation, Solution by the Method of Separation of Variables, using Fourier Series, D'Alembert's Solution of the Wave Equation, Heat Equation; its Solution by Fourier Series and Fourier Integrals, Rectangular and circular membrane, Use of Double Fourier Series, Laplace's Equation, Laplacian in Spherical Coordinates, Solution of PDEs by Laplace and Fourier transforms.

Recommended Books:

1. Advanced Engineering Mathematics (Latest Edition) by E. Kreyszig.
2. Vector and Tensor Analysis with Applications by Borisenko & Taranov, Latest Edition.

GS-3xx NUMERICAL METHODS

Theory Cr Hrs, 2
Lab Cr Hrs, 1

Course Objectives:

This course introduces students to a variety of numerical methods to solve a broad range of engineering problems.

Topics Covered:

Floating Point number system, Stability of Algorithm and Error analysis, Iterative Methods for the Solutions of Non-Linear Equations, Fixed point Method, Newton-Raphson Method, Secant Method, Bisection Method, Regula-Falsi Method; Convergence, Interpolation: Lagrange Interpolation, Newton's Divided Difference, Forward Difference and Backward Difference Interpolations, Numerical Differentiation, Cubic Spline Interpolation, Numerical Integration: Rectangular, Trapezoidal and Simpson's Rules, Determination of Required Accuracy.

Numerical Methods in Linear Algebra. Systems of linear Equations, Gauss Elimination Method, LU Factorization: Doolittle's, Crouts's and Cholesky's Methods, Iterative Methods for Systems of Equations: Gauss-Seidel Method, Jacobi's Method, Method of least squares, Evaluation of Eigen values by Iteration: Power Method, Eigenvectors.

Solution of 1st and 2nd Order Ordinary Differential Equations: Euler Method, Heun's Method, Runge-Kutta, Method, Runge-Kutta-Nystrom Method,

Solution of Elliptic Partial Differential Equations, Laplace and Poisson Equations, Dirichlet Problem, Neumann and Mixed Problem, Irregular Boundary, Solution of Parabolic PDEs: Crank-Nicolson Method, Solution of Hyperbolic PDEs.

Recommended Books:

1. Applied Numerical Analysis by Curtis F.Gerald Patrick O.Wheatley, Latest Edition.
2. Numerical Analysis For Applied Mathematics, Science, and Engineering by Donald Greenspan & Vincenzo Casulli, Latest Edition.
3. Numerical Methods and Software by David Kahaner, Latest Edition.

GS-3xx PROBABILITY AND STATISTICS

Theory Cr Hrs, 3
Lab Cr Hrs, 0

Course Objectives:

This course introduces the concepts of probability and statistics. The student would be able to apply this knowledge on a wide variety of engineering problems.

Topics Covered:

Graphical Representation of Data: Stem-and-Leaf Plot, Histogram, Box plot; Mean, Standard Deviation, Variance ,Sample Space, Experiment Outcomes, Sampling with and without replacement, Set theory, Introduction to theory of Probability, Theorems of Probability, Conditional probability, Permutations and Combinations, Random Variables and Probability Distributions, Mean and Variance of a Distribution, Expectation, Moments.

Binomial, Poisson & Hyper geometric distributions, Normal distribution, Marginal distribution, Distributions of Several Random Variables, Random Sampling, Random numbers, Processing of Samples, Estimation of parameters, Confidence intervals, Testing of hypothesis, Quality control, Control chart, Acceptance sampling, errors & rectification, Goodness of Fit, Chi-square test. Curve fitting, Regression Analysis, Curve Fitting.

Recommended Books:

1. Probability and Statistics by Murray R. Spiegel (Latest Edition).
2. Advanced Engineering Mathematics (Latest Edition) by E. Kreyszig.

GS-1xx APPLIED PHYSICS

Theory Cr Hrs, 3
Lab Cr Hrs, 0

Course Objectives:

The course is aimed at teaching students the fundamentals of applied engineering physics. The course is intended to laying the foundation of students before they encounter hardcore engineering subjects.

Topics Covered:

Polarization and Speed of light, EM Spectrum, Reflection & Refraction, Geometrical optics of spherical mirrors and refracting surfaces, Fiber Optics, Simple Harmonic motion, Waves in elastic media (Strings and acoustical pipes)

General solutions to the wave equation, Geometrical optics of spherical mirrors and refracting surfaces, thick and thin lenses, Optical instruments, Mechanical properties of materials.

Recommended Books:

1. Physics by Tom & Duncon, Latest Edition.
2. Physics (Latest Edition) by Halliday & Resnick.

CS-1xx COMPUTER PROGRAMMING

Theory Cr Hrs, 3
Lab Cr Hrs, 1.

Course Objectives:

This course is intended to provide latest approaches in algorithm development and computer programming using a modern language like C/C++.

Topics Covered:

Introduction to Computer Organization, Algorithms, Computer languages, Compiler, Assembler and Interpreter. A typical IDE (Microsoft Visual C++ 6.0), Data, Data types, Data representation, Identifiers, Reserved words, Variables and constants, Inputs and outputs, Standards Library, Arithmetic and logical Operators, If and If/else statements and conditional expressions , Switch statements, Loops, Functions, Arrays, input and output of data, searching and sorting, Pointers, Structures, Structure declaration, accessing structure members, array of structures, Passing structures as function arguments, Files handling , Introduction to Object Oriented programming.

Recommended Books:

1. C++ How to program by Deitel and Deitel, Prentice hall, Latest Edition, ISBN: 0-13-185757-6.
2. Programming with ANSI C by B. J. Holmes, Latest Edition.
3. C for yourself by Richard P. Halpern, Latest Edition.

CS-2xx DATA STRUCTURES AND OBJECT ORIENTED PROGRAMMING

Theory Cr Hrs, 2
Lab Cr Hrs, 1

Course Objectives:

To teach students different data structures that are required to design and implement various software projects. The course also aims to teach the implementation of data structures using object-oriented language C++. It will familiarize the students with practical applications of data structures. The students will also be taught basic techniques for analysis of algorithms.

Topics Covered:

Introduction to Object Oriented Programming, Introduction to Data Structures and C++, Abstraction and ADT"s Built-in Data Structures in C++, Linked Lists, Stacks and Queues, Recursion, Trees, Sorting and Searching, Classes, Objects, Access Specifiers, Data Members, Member Functions, Abstract Data Types (ADT), Information Hiding, Encapsulation and Reference Variables, Constructors and Destructors, Overloaded Constructors, Default Constructors, Copy Constructor, Conversion Constructor, Shallow vs Deep Copy, Properties, Getters and Setters, Static Data Members and Static Member Functions, Function Overloading, Operator Overloading and Templates, Inheritance, Types of Inheritance, Derived Classes and Method Overriding.

Recommended Books:

1. Mark Allen Weiss, “Data Structures and Problem Solving Using C++”, 3rd Ed, Addison Wesley, 2009.
2. Dietel and Deitel, “C++ How to Program”, 7th Ed, Prentice Hall 2009.
3. Michael T. Goodrich, Roberto Tamassia, David Mount, “Data Structures and Algorithms in C++”, Wiley, 2004.
4. Frank M. Carrano, “Data Abstraction and Problem solving with C++”, 3rd Ed., Addison Wesley, 2004.
5. Adam Drozdek, “Data Structures and Algorithms in C++”, 3rd Ed., Thomson, 2005.
6. Robert Lafore, “Object Oriented Programming with C++”, Sams, 2002.
7. Booch and Rumbaugh, “The Unified Model Language User Guide”, 2nd Ed, Addison Wesley, 2005.

CS-2xx DIGITAL LOGIC DESIGN

Theory Cr Hrs, 3
Lab Cr Hrs, 1

Course Objectives:

This course introduces the foundation of Digital Computer Design. Numbering systems and Boolean algebra become the basis of this course. At the end of the course, the students should be able to design different combinational and sequential circuits leading to the design of complex digital systems such as ALU.

Topics Covered:

Numbering System, Boolean algebra, Logic Gates and truth tables, Karnaugh Maps, minimization techniques for digital circuits, Combinational Logic Design, Combinational Logic with MSI and LSI, Flip Flops and Latches, Sequential Logic Design, Registers and Counters, ALU Design, Finite State Machine (FSM), Memory and Programmable Logic Devices. Introduction to HDL.

Recommended Books:

1. Digital Logic and Computer Design by M. Morris Mano, Prentice Hall (India), Latest Edition.
2. Digital Fundamentals by Thomas L. Floyd, Latest Edition, Prentice Hall International.
3. Digital Logic & State Machine Design by David J. Comer Latest Edition, Saunders College publishing.
4. Logic Circuit Design by A.W. Shaw, Oxford University Press, Latest Edition.
5. Digital Computer electronics by Malvino and Brown, Career Education, Latest Edition.

ME-1xx WORKSHOP PRACTICE

Theory Cr Hrs, 0
Lab Cr Hrs, 2

Course Objectives:

The students are made familiar with engineering processes in various workshops. They get hands on experience so that they are well aware of the trends and techniques in various technologies employed in order to solve engineering problems.

Topics Covered:

Basic theory and practice on the following shops: Fitting shop, Woodwork shop, Electrical shop, Forging shop, Foundry Shop, Elementary Machine

shop (Lathe & Milling), Welding shop, PCB soldering, Introduction to computer hardware.

Recommended Books:

1. Workshop Technology, Part I & II, by W. A. Chapman, Arnold Pub, Latest Edition.
2. Workshop Technology, Part III by W. A. Chapman, Arnold Pub, Latest Edition.
3. Any book of manufacturing processes.

ME-1xx ENGINEERING DRAWING

Theory Cr Hrs, 1
Lab Cr Hrs, 2

Course Objectives:

The objective of this course is to learn the language of engineering and technical drawing. Students learn basic drafting using both manual and computer aided techniques. At the end of the course students will be able to read, draw and modify engineering drawings both in manual and digital formats in such details that is suitable to both designer and manufacturer.

Topics Covered:

Engineering Drawing

Introduction to Engineering Drawing, Types of lines and usage, Basic geometrical Constructions, Theory of Orthographic projection; First angle and third angle projections. Dimensioning and lettering, Tolerances, Fits, Projections of points, straight lines, planes and solids. Sectioning of solids, Isometric projections, Development of surfaces, Drawing symbols.

CAD Package

Introduction to CAD tool, Understanding and drawing simple 2D objects, Coordinate systems, Modifying drawing objects. Drawing in layers, creating complex drawings, Sectioning, Hatching, Text, Blocks, Dimensioning, Isometric views, Fits and Tolerance, Symbols for welding, Surface finish, Threaded parts, electronics, Solids and surfaces, Extracting views from model space into paper space, Creating layouts in Paper space, Plotting a drawing, Plotting from model space.

Recommended Books:

1. First year Engineering Drawing, by A. C. Parkinson, Latest Edition.
2. Engineering Drawing and Graphic Technology, by T. E. French, C. J. Vierck, R. J. Foster, McGraw Hill.
3. CAD Packages by T.F. French.
4. Any book relevant to the CAD tool used in the lab.

ME-1xx ENGINEERING STATICS

Theory Cr Hrs, 3
Lab Cr Hrs, 0

Course Objectives:

The objective of this course is to develop the capacity to predict the effects of force system while carrying out the creative design function of engineering.

Topics Covered:

Force System

Force and its rectangular and oblique axis components (two and three dimensional systems). Moment and resultant couple (two and three dimensional systems). Equilibrium Mechanical systems, free body diagram and equilibrium conditions for two and three dimensional systems, Structures, Plane trusses. Solution of plane trusses with method of joints and method of sections, Frames.

Distributed Forces

Centroids, composite centroids, Distributed force system.

Friction

Types of friction, Application of friction.

Recommended Books:

1. Engineering Mechanics (Vol. 1) by R. C. Hibbler, Pearson, Latest Edition.
2. Engineering Mechanics (Vol. 1) by J. L. Meriam & L. G. Kraige, Wiley, Latest Edition.
3. Mechanics for Engineers, Statics, by F. P. Beer & E. R. Johnston, McGraw Hill, Latest Edition.
4. Engineering Mechanics: Statics & Dynamics (Vol. 1) by I. H. Shames, Prentice Hall, Latest Edition.

ME-2xx ENGINEERING DYNAMICS

Theory Cr Hrs, 3
Lab Cr Hrs, 0

Course Objectives:

The objective of this course is to develop the capacity to predict the effects of force and motion while carrying out the creative design function of engineering.

Topics Covered:

Kinematics of Particles

Rectilinear motion, Plane curvilinear motion, Rectangular coordinates, Normal and tangential coordinates, Polar coordinates, constrained motion.

Kinetics of Particles
Force, mass, and acceleration, Newton's second law of motion, equations of motion, Rectilinear and curvilinear motion, Work and energy principle, potential energy, Impulse and momentum, conservation of momentum.

Plane Kinematics of Rigid Bodies
Angular motion relations, concept of absolute and relative motion (velocity and acceleration), Instantaneous centre of zero velocity.

Plane Kinetics of Rigid Bodies
Force, mass, and acceleration, general equation of motion, Translation, fixed axis rotation, Work and energy relationship, Impulse and momentum equation.

Recommended Books:

1. Engineering Mechanics dynamics by R. C. Hibbeler, Pearson, Latest Edition.
2. Engineering Mechanics (Vol. II) by J. L. Meriam & L. G. Kraige, Wiley, Latest Edition.
3. Mechanics for Engineers, Dynamics, by F. P. Beer & E. R. Johnston, McGraw Hill, Latest Edition.
4. Engineering Mechanics: Statics & Dynamics by I. H. Shames, Prentice Hall, Latest Edition.

ME-2xx MECHANICS OF MATERIALS

Theory Cr Hrs, 2
Lab Cr Hrs, 1

Course Objectives:

This course is a foundation to many advanced techniques that allow engineers to design structures, predict failures and understand the physical properties of materials. Mechanics of Materials provides the students basic tools for stress, strain and strength analysis. Methods for determining the stresses, strains and deflections produced by applied loads are learned.

Topics Covered:

Concepts of stress and strain, Axial loading, Torsion, Pure bending, Shear Force and Bending Moment Diagrams, Beams under transverse loading, Transformation of stress and strain, biaxial stress, Mohr's Circle, Deflection of beams, Beam design, Columns.

Recommended Books:

1. Mechanics of Materials by E. P. Popov, Prentice Hall Inc., Latest Edition.
2. Mechanics of Materials by F. P. Beer and E. R. Johnson, Latest Edition.

3. Strength of Materials by J. Alexander, Latest Edition.
4. Mechanics of Engineering Materials by P. P. Crawford, Latest Edition.
5. Mechanics of Materials, by R. C. Hibbeler, Pearson, Latest Edition.
6. Mechanics of Materials by Anscl C. Ugural, Wiley, Latest Edition.
7. Strength of Materials, by A. Pytel and F. L. Singer, Harper and Row, Latest Edition.

ME-2xx MATERIALS AND MANUFACTURING PROCESSES

Theory Cr Hrs, 3
Lab Cr Hrs, 0

Course Objectives:

This course is designed to introduce the students to the structures and properties of materials. This course also provides the students an insight into different manufacturing processes used in the industry.

Topics Covered:

Engineering Materials

Engineering Properties of Materials, Concept of Structures, Metals and Alloys, Ceramics, Polymers, Composites, Semiconductors, Materials Characterization, Scanning Probe Microscopy, Non-Destructive Testing, and Material Selection.

Manufacturing Processes

Manufacturing Systems, Modern Casting, Conventional machining; turning, milling, tool geometry, chips formation, material removal rate. Non-conventional machining; EDM, ECM, water jet machining, laser, EBW etc. Welding Processes, Heat Treatment, Electronic Fabrication, Rapid Prototyping.

Recommended Books:

1. Elements of Material Science and Engineering by L. H. Van Vlack, Addison Wesley Publishing Co., Latest Edition.
2. Engineering with Polymers by P. C. Powell, Chapman and Hall, Latest Edition.
3. Manufacturing Processes by Amstead, Begeeman and Ostwald, John Wiley & Sons, Latest Edition.
4. Materials and Processes in Manufacturing by E. Paul DeGarmo, Wiley, Latest Edition.

ME-3xx THEORY OF MACHINES

Theory Cr Hrs, 2
Lab Cr Hrs, 1

Course objectives:

The objective of the course is to introduce the preliminary concepts of mechanisms and to present methods of analysis for the motion and force transmission in mechanisms. After this course the students are able to understand the various independent technical approaches that exist in the field of mechanisms, kinematics, and machine dynamics.

Topics Covered:

Kinematics Fundamentals, Degrees of Freedom, Different types of mechanisms, their characteristics and applications, Position, Velocity and Acceleration analysis, Dynamic force analysis, Static and dynamic balancing, Cam and gear (gear trains) design.

Recommended Books:

1. Design of Machinery by R. Norton, McGraw Hill, Latest Edition.
2. Theory of Machines and Mechanisms by Joseph E. Shigley and John Joseph Uicker, McGraw Hill, Latest Edition.
3. An introduction to Synthesis and Analysis of Mechanisms and Machines by McGraw Hill Series in Mechanical Engineering, Latest Edition.
4. Mechanisms and dynamics of Machinery, by Hamilton H Mabie, John Wiley, Latest Edition.

ME-2xx THERMODYNAMICS

Theory Cr Hrs, 2
Lab Cr Hrs, 1

Course Objectives:

This course gives introduction of basic concepts of thermodynamics, like system, surrounding, work, heat, and different process to the students. It will also introduce steady flow and non-steady flow processes and basic steam and gas turbine cycles.

Topics Covered:

Properties of matter, the state postulate, energy, processes and thermodynamic systems. Properties of pure substances: property tables, property diagrams, phase change, equations of state (ideal gas). Energy: Energy transfer by heat, work and mass. The first law of thermodynamics: Closed system, open system, steady flow engineering devices. The second law of thermodynamics: Statement of the 2^{nd} law, heat engines, refrigeration devices, reversible vs. Irreversible processes, the Carnot cycle, Entropy, Clausius inequality, the increase in entropy principle, entropy change of pure

substances, the T-S relations for ideal gases: Basic concept of Exergy, Thermodynamic cycles – Rankin steam cycle, Gas turbine cycles, and the ideal Otto and Diesel cycles.

The lab work may include hands-on experience of EES® (Engineering Equation Solver).

Recommended Books:

1. Fundamentals of Thermodynamics, Richard E. Sonntag, Claus Borgnakke and Gordon J. Van Wylen, John Wiley & Sons, Latest Edition.
2. Fundamentals of Engineering Thermodynamics by Micheal J. Moran and Howard N. Shapiro, John Wiley & Sons.
3. Engineering Thermodynamics by Merle C Potter and Craig W. Somerton, McGraw Hill Companies Inc.
4. Manufacturing processes and equipment, by George Tlusty, Prentice Hall, Latest Edition.

EE 1xx ELECTRIC CIRCUITS

Theory Cr Hrs, 3
Lab Cr Hrs, 0

Course Objectives:

This is the electrical foundation course in Mechatronics Engineering. The course aim is to familiarize the students with passive electrical components and circuit analysis principles.

Topics Covered:

Basic Circuit Elements, Ohm's law, KCL and KVL, Node and Mesh Analysis, Series and Parallel Circuits, Linearity and Superposition Principles, Network Laws like Thevenin and Norton Theorem, Maximum Power Transfer Theorem, Inductive and Capacitive circuits, concepts of circuit reactance and impedance, Laplace Transform of circuit equations, Basic operational amplifier circuits; Inverting Non Inverting Amplifiers, Summing and Difference Amplifiers, Integrator and Differentiator, Poly-phase circuits and phasors.

Recommended Books:

1. Fundamentals of Electric Circuits by Sergio Franco Oxford English Press, Latest Edition Engineering Circuit Analysis by Hayt, Kimmerly and Durbin, McGrawHilll, Latest Edition.

EE-2xx ELECTRONIC DEVICES AND CIRCUITS

Theory Cr Hrs, 3
Lab Cr Hrs, 1

Course Objectives:

This course explains the basic concepts of semi-conductor and PN junction. Semiconductor devices including Diodes, Bipolar Junction Transistors (BJTs), Field Effect Transistors (FETs) and their application circuits are discussed in detail.

Topics Covered:

Basic concepts of semiconductor and PN junction physics, Diodes, terminal characteristics of junction diodes, analysis of diode circuits, small signal model and its applications, Zener diodes, Rectifier circuits, Limiting & Clamping circuits.

Physical Structure and operating principles of BJTs, basic BJT circuit configurations, DC analysis, Small signal and Large signal models of BJT, BJT as a switch.

Physical Structure and operating principles of FETs, MOSFETs, Enhancement and Depletion type MOSFETs, basic MOSFET circuit configurations, DC analysis, Small signal and Large signal models of MOSFETs.

Recommended Books:

1. Microelectronics Circuits, Latest Edition By A.S. Sedra & K. C. Smith Oxford University Press.
2. Microelectronics, Latest Edition, by Millman & Grabel, McGraw Hill.
3. Electronic Devices & Circuit Theory, Latest Ed., by R. Boylestad and L. Nashelsky.

MTE-2xx ELECTROMECHANICAL SYSTEMS

Theory Cr Hrs, 3
Lab Cr Hrs, 1

Course Objectives:

This course teaches the basic principles of electromechanical systems like transformers, generators and motors. Faraday's law is explained and it leads to rotating machines. At the end of the course, the students should be able to characterize and model the electromechanical systems.

Topics Covered:

Magnetic circuits, Electromagnetic circuits; Solenoids, Transformers, Transformer coupled circuits. Principles of Electro-mechanical energy

conversion and rotating machines, Construction and operation of synchronous generator, Construction and operation of synchronous motor, Induction machines and their characteristics, Applications of AC motors, Operating principles of DC machines, Performance analysis of the DC machines, Modeling of DC motor, Bush less DC motor, Switched reluctance motor. Visualization of characteristics using MATLAB is encouraged.

Recommended Books:

1. Electric Machinery Fundamentals by Stephen J Chapman, Latest Ed.
2. Electric Machinery and Transformers by Guru and Hiziroglu, Latest Ed.
3. Electric Machinery Fritzgerald, Charls Kingesly and Umans, Latest Ed.

ME-2xx FLUID DYNAMICS, HYDRAULICS AND PNEUMATICS

Theory Cr Hrs, 3
Lab Cr Hrs, 1

Course Objectives:

The objective of this course is to introduce the preliminary concepts of fluid dynamics, hydraulics, and pneumatics. Particular focus is on application of hydraulics and pneumatics in Mechatronics systems.

Topics Covered:

Fluid Dynamics

Definition of a fluid, fluid properties, equation of state, Hydrostatics: Manometry, Principles of Fluid Motion: Description of fluid flow; continuity equation; Euler and Bernoulli equations;, Laminar and Turbulent Flows: Reynolds demonstration of flow regimes; criterion for laminar/ turbulent flow; Reynolds number. Pipe Flows: friction factor, friction losses, and other losses.

Hydraulics and Pneumatics

Hydraulic and pneumatic actuating devices, hydraulic valve types, configuration and characteristics responses, Pneumatic valve types, configuration and characteristic responses, Design and application of hydraulic and pneumatic systems.

Recommended Books:

1. Fundamentals of Fluid Mechanics by Bruce R. Munson, Donald F. Young and Theodore H. Oliishe, Wiley, Latest Edition.
2. Pneumatics and Hydraulic Systems, by W. Bolton, Butterworth Heinemann Ltd., Latest Edition.
3. Fluid Mechanics and Hydraulic Machinery, by K. R. Arora, Standard Publisher, Latest Edition.

MTE-3xx HEAT TRANSFER

Theory Cr Hrs, 2
Lab Cr Hrs, 1

Course Objectives:

This course introduces the basic concepts of heat transfer, in conduction, convection, and radiation. It also deals with extended surfaces to increase heat transfer and its applications in heat sinks and in heat exchangers. The effect of heat transfer on cooling and heating is also discussed.

Topics Covered:

Introduction to conduction, 1-D heat transfer, heat transfer through composite walls, cylinders and spheres. Design and analysis of fins and its application in heat sinks. Variable thermal conductivity. Introduction to free and forced convection, Thermal boundary layer, flow over plates, flow within pipes, laminar and turbulent flow correlations. Introduction to heat pipes, Design of heat exchangers using effectiveness-Ntu approach and LMTD approach. Introduction to radiation heat transfer.

The lab work may include hands-on experience of EES® (Engineering Equation Solver).

Recommended Books:

1. Introduction to heat transfer, by F. P. Incropera and D. P. Dewitt, John Wiley & Sons, Latest Edition.
2. Heat Transfer, by J. P. Holman, McGraw Hill Book Co., 1997.
3. Heat Transfer, by Y. A. Cengel, WBC McGraw Hill, Latest Edition.

EE-1xx NETWORK ANALYSIS

Theory Cr Hrs, 2
Lab Cr Hrs, 1

Course Objectives

This course focuses on time domain and frequency domain analysis of First and Second Order Electric Circuits with AC and DC forcing function. The course also covers the frequency response of a circuit through sinusoidal analysis.

Topics Covered

Natural response of 1st order circuits, 1st order circuits with dependent sources, Response of 1st order circuits to constant forcing function, Response of 1st order circuits to non-constant forcing function, Complete response of 2nd order circuits. Solving Circuit differential equations using

Laplace transform, Laplace transform of special signals, Direct transformation of circuits in to s-domain.

AC steady state power, Concepts of average power, complex power and power factor, Frequency response of 1st and 2nd order circuits (passive filters), Asymptotic magnitude and phase Bode plots.

Recommended Books:

1. Fundamentals of Electric Circuits by Sergio Franco Oxford English Press, Latest Edition.
2. Engineering Circuit Analysis by Hayt, Kimmerly and Durbin, McGraw-Hill, Latest Edition.

EE-2xx ELECTRONIC CIRCUIT DESIGN

Theory Cr Hrs, 3
Lab Cr Hrs, 1

Course Objectives:

This course covers the different aspects of Amplifier circuit Design and in-depth analysis of these circuits including frequency response, internal design of Operational Amplifiers. It also includes the design of special electronic circuits.

Topics Covered:

Frequency response of different single stage amplifier configurations of BJTs and MOSFETs, Miller's theorem, Differential and Multistage Amplifiers, Feedback configurations. Internal design of operational amplifiers; input stage, current source, output stage. Active Filters, Signal generators (RC oscillator, multivibrators), integrated circuit timers (different modes of 555), CMOS Logic gates and relay drive circuits.

Recommended Books:

1. Microelectronics Circuits, Latest Edition By A.S. Sedra & K. C. Smith Oxford University Press.
2. Microelectronics, Latest Edition., by Millman & Grabel, McGraw Hill.
3. Electronic Devices & Circuit Theory, Latest Ed., by R. Boylestad and L. Nashelsky.

MTE-3xx MICROCONTROLLER BASED DESIGN

Theory Cr Hrs, 2
Lab Cr Hrs, 2

Course Objectives:

This course covers the microprocessors and microcontrollers, the core of a digital system. The architecture, assembly/C language, system development/simulation tools for a modern (RISC/CISC) microcontroller are introduced. Complete digital systems with different peripherals and data communication are designed, simulated and implemented.

Topics Covered:

Introduction to Microprocessors and Microcontrollers, concept of embedded system design, architecture of a modern microcontroller, Software/firmware development tools, Programming languages; Assembly and C, Simulation tools like Proteus, Digital systems design using internal resources, external peripherals and devices, Implementation of data communication; RS-232, I2C, SPI etc.

Recommended Books:

1. PIC Microcontroller and Embedded Systems using Assembly and C for PIC 18 by Muhammad Ali Mazidi, Prentice Hall.
2. AVR Microcontroller and Embedded Systems using Assembly and C. by Muhammad Ali Mazidi, Prentice Hall.
3. 8051 Microcontroller and Embedded Systems by Muhammad Ali Mazidi, Prentice Hall.

MTE-3xx TRANSDUCERS AND INSTRUMENTATION

Theory Cr Hrs, 3
Lab Cr Hrs, 1

Course Objectives:

To teach the operating principles of various types of sensors and to introduce the concepts & designs of instruments for the measurement of electrical and non-electrical quantities.

Topics Covered:

Measurements terminologies including resolution, sensitivity, accuracy, and uncertainty, engineering units and standards. Principles of different measurement techniques. Sensors for measurement of temperature; Thermocouples, RTDs, Thermisters. Sensors for displacement and position; digital encoders, shaft encoders, absolute and relative encoders, linear encoders. Sensors for force, pressure, strain, vibration, velocity, flow rates etc. Signal conditioning and filter design. Types of bridge circuits for

measurement of resistance, inductance, and capacitance. Analog to digital conversion. Systems for signal processing and signal transmission. Data recording and data acquisition systems. Microprocessor based instrumentation circuits.

Recommended Books:

1. Klaas B. Klaassen and Steve Gee “Electronic Measurement and Instrumentation”, Cambridge University Press, ISBN: 0521477298.
2. Kevin James, Newness “PC Interfacing and Data Acquisition Techniques for Measurements, Instrumentation and Control”, Newness, ISBN: 0750646241.

ME-3xx CONTROL SYSTEMS

Theory Cr Hrs, 3
Lab Cr Hrs, 1

Course Objectives:

The objective of the course is to teach the students about the basic analysis and synthesis tools used in the design of feedback control systems. The students are also familiarized with industry standard software tools such as Matlab®, Simulink®, Scilab, and Octave to analyze, design, and evaluate control systems.

Topics Covered:

Basic Concepts, Modeling of Electrical, Mechanical and Electro-Mechanical Systems, Transfer functions, Block Diagrams and Signal Flow Graphs. Response of First and Second Order Systems, Asymptotic/BIBO Stability and Routh-Hurwitz Stability Criterion. Performance Specifications of Linear Time-Invariant Control Systems, PID controller design, Root Locus Analysis, Root Locus Design, Frequency Response Analysis, Frequency Response Design, Bode plots, and Nyquist criterion. State space analysis and design.

Recommended Books:

1. Design of Feedback Control Systems, by R. T. Stefani, C. J. Savant, B. Shahian, G. H. Hostetter, OUP, USA, Latest Edition.
2. Feedback control systems, by Phillips and Harbor, Prentice Hall, Latest Edition.
3. Control Systems Engineering, by N. Nise, Wiley-VCH. Latest Edition.
4. Modern Control Engineering, by K. Ogata, Pearson Education, Latest Edition.
5. Modern Control Systems, by Richard C. Dorf, and Robert H. Bishop, Pearson Education Ltd., Latest Edition.
6. Automatic Control Systems, by F. Golnaraghi, and Benjamin C. Kuo, John Wiley & Sons, Latest Edition.

MTE-3xx DESIGN OF MACHINE ELEMENT & CAD/CAM

Theory Cr Hrs, 2
Lab Cr Hrs, 1

Course Objectives:

To provide detailed conceptual understanding to design, build and analyse machine elements using computer-aided tools. This course provides students with an opportunity to familiarize with different CAD packages (e.g. Pro Engineer / SolidWorks / CATIA / NX / ANSYS) and its connection to CAM.

Topics Covered:

Theory Portion:

Introduction to Static Loading, Factors of Safety, Failure Theories, Failure of Ductile /Brittle Materials. Introduction to design, Basic concepts in design of machine parts, Factor of Safety, Codes and Standards, Role of Economics, Reliability, Fits, Allowances and tolerances.

Threaded Fasteners, Riveted joints, Keys and Cotters, Pins and Knuckle joints, Welded Joints, Clutches, Brakes, Fly wheels and couplings, rolling and general bearings, Belts, Ropes and Chains, Mechanical springs, Shafts, linear motion guides, ball screws.

Lab Portion:

3D Modelling, Assembly and drawing using CAD packages (e.g. Pro Engineer®, Solid Works®, Solid Edge®), CAM tools (e.g. G-Simple).

Recommended Books:

1. Mechanical Engineering Design, by Joseph Edward Shigley, McGraw Hill, Latest Edition.
2. CAD/CAM Principles and Applications by P. N. Rao, McGraw Hill, Latest Edition.
3. Fundamentals of Machine Component Design, by R. C. Juvinall, and K. M. Marshek, John Wiley, Latest Edition.

MTE-4xx MECHANICAL VIBRATIONS

Theory Cr Hrs, 2
Lab Cr Hrs, 0

Course Objectives:
This course gives knowledge of vibrations in rotating and oscillating bodies.

Topics Covered:
Fundamentals of vibration, classification of vibration, analysis and elements of vibratory system. Simple harmonic analysis, Un-damped and damped free vibration, introduction to forced vibration with harmonic excitation. Forced vibration with Viscous and Coulomb damping, self excitation stability analysis, whirling of rotating shafts. Balancing of rotator machinery, coordinate coupling, principle coordinates, and multi degrees of freedom system. Numerical techniques used in vibration, such as, Holzer method, Influence Coefficient, and Eigen value problems.

Recommended Books:
1. Mechanical Vibrations, by Singiresu S. Rao, Pearson education publishing company, Latest Edition.
2. Vibration theory and applications, by William T. Thomson, Lewis reprints limited, Latest Edition.
3. Mechanical Vibrations, Schuam's outline series in Engineering, by Seto. Latest Edition.

MTE-3xx POWER ELECTRONICS

Theory Cr Hrs, 3
Lab Cr Hrs, 1

Course Objective:
To teach electronic devices and circuits used in power electronic applications.

Topics Covered:
Power electronic devices; power diode, power MOSFET, SCR, GTO Thyristor, IGBT, TRIAC, DIAC. Thyristor gate drive and commutation circuits, low-side and high-side drives. Uncontrolled, semi-controlled and fully-controlled rectifiers, single-phase and three-phase rectifiers. AC choppers. Pulse width modulation (PWM). Inductor design for switching applications, DC-to-DC converters; buck, boost, buck-boost, Cuk converters, resonant converters. H-bridge circuit design. Switched mode power supplies. Pulse-width-modulated (PWM) amplifiers/inverters (single and three-phase). DC motor drives. Stepper motor drives. UPS (square-wave, quasi sine/square-wave and sine-wave). AC motor drives. Industrial heating; induction furnace,

dielectric furnace etc. Practical/commercial devices for PWM generation, high-side drives, switching regulators etc.

Lab work will include implementation of rectifiers, converters and drives, Microcontroller based implementation of converters and motor drive circuits (application notes etc.).

Recommended Books:

1. M.S. Jamil Asghar, “Power Electronics” Prentice Hall India, ISBN: 81-20-3-2396-3.
2. Ned Mohan, William P. Robbins and Tore M. Undeland, “Power Electronics: Converters, Applications and Design,” Media Enhanced, Third Edition, 2003, John Wiley & Sons, ISBN: 0471429082.
3. Cyril W. Lander, “Power Electronics,” Third Edition, 1993, McGraw-Hill UK, ISBN: 0077077148.
4. Muhammad H. Rashid, “Power Electronics: Circuits, Devices and Applications,” Third Edition, 2004, Prentice Hall, ISBN: 0131011405.
5. B. K. Bose, “Modern Power Electronics and AC Drives,” Prentice Hall, ISBN: 013-0167436.

MTE-4xx INDUSTRIAL AUTOMATION

Theory Cr Hrs, 2
Lab Cr Hrs, 1

Course Objectives:

The course covers manufacturing automation with particular reference to CNC and PLC. After this course, the students would be able to understand the automation requirements of a modern manufacturing set-up.

Topics Covered:

Manufacturing Automation
Automation Theory; Fordism, Toyotism. Driving Forces and Manufacturing Strategies, Designing for Automation, Opportunities and Pitfalls of Automation.

Computer Numerical Control (CNC) Machining Requirements, Limitations of Conventional Machining, Advent of Numerical Control, Impact of Computer Technology, Building blocks of CNC, CNC Programming, Machining Codes, Computer Assisted Programming, CAD/CAM.

Programmable Logic Controllers (PLC)
Introduction to PLC, PLC Architecture and Operation, Advantages / Limitations of PLC, Ladder Logic and other Programming Formats, Relay Logic, Timers, Counters, Comparator and Misc Math Instructions, Advent of

Numerical Control, Bit Shift Registers, Advanced Applications, Fieldbus, industrial data communication protocols, SCADA, HMI.

Recommended Books:

1. Robots and Manufacturing Automation, by C. Ray Asfahl, John Wiley & Sons, Latest Edition.
2. CAD/CAM Principles and Applications, by P N Rao, McGraw Hill, Latest edition.
3. Programmable Controllers, by E. A. Parr, Newnes, Latest edition.
4. Automation Production Systems and Computer Integrated Manufacturing, by Mikeel P. Groover, Prentice Hall, Latest Edition.

MTE-3xx MECHATRONICS SYSTEM DESIGN

Theory Cr Hrs, 2
Lab Cr Hrs, 2

Course Objectives:

This course focuses on the synergetic integration of the knowledge of mechanical engineering, electronics, and computer engineering to achieve a functional multi-axis position control system. In this course, students practically develop a position control system like CNC XY-table, Robot, or AGV in the lab. Theory class is used for background knowledge required to design the system, numerical calculations and the development of a design document.

Topics Covered:

Optimum design process. What steps design engineers follow to design a system? Requirements analysis. Meeting standards. International standards for industrial equipment, embedded systems, standards for safety critical systems like robots and AGVs etc. Format and layout of Design Document.

Mechanical Design: Mathematical Model. General equation of motion for a mechatronic system. Estimating Motor torques based on inertia of the system and the desired maximum velocity and acceleration. Estimating frictional forces due to dry friction and misalignment. Designing for low friction and high-rigidity systems. Design of mechanical drive system. Ball screw design. Design of Linear Motion guides. Preparing workshop drawings of various mechanical components using CAD. Preparing part program files for CNC machining of components using G-Simple or any other CAD/CAM package. These drawings and CNC codes will later become part of the final design document.

Electronics and Software Design:
Evolving schematic circuit diagrams for the electronic circuitry. H-bridge circuit design for servo motor control. Components selection. Development of

computer hardware using modern microcontrollers or DSPs. Pulse encoder interface circuit. Implementation of PID control algorithm. Interfacing other sensors with the microcontroller. Path planning algorithm, trajectory generation. Front-end design. Data communication with other devices.

Course Project:
Design and develop a CNC XY-table, robot, or AGV in the lab and submit the design document in the given format.

Recommended Books:

1. Devdas Shetty and Richard Kolk "**Mechatronics System Design**", Brooks/Cole CENGAGE Learning, 2008. ISBN 81-315-0119-1.
2. Rajput, R K. "**A Text Book of Mechatronics**", S. Chand & Company Ltd., Ist ed.2007. ISBN 81-219-2859-1.
3. Saeed B. Niku "**Introduction to Robotics Analysis, Systems, Applications**", Pearson Education Inc., NJ, USA, 2001. ISBN 978-81-203-2397-7.

MTE-4xx ROBOTICS

Theory Cr Hrs, 3
Lab Cr Hrs, 1

Course Objectives:

To develop a working knowledge of the mathematical aspects of robot manipulator analysis and control.

Topics Covered:

Types of robots, Types of joints used in robots, Degree of freedom and constraints, Types of planar and spatial mechanisms, Transformations from one system to the other, Forward and Inverse kinematics, Jacobian, Velocity and Force Analysis, Dynamics of robots, Path planning and trajectory analysis, Mechanism design (serial and parallel) used in robots, Linear control of manipulators, Sensors and actuators used in robotics, MEMS.

Recommended Books:

1. Introduction to Robotics, by J. J. Craig, Addison-Wesley, Latest Edition.
2. Introduction to Robotics, by O. Khatib and K. Kolarov, Latest edition.
3. Robot dynamics and Control, by M. W. Spong and M. Vidyasagar, Wiley & Sons, Latest Edition.
4. Robotics and Automation: An introduction to Cams, Mechanisms, and Robotics, by D. Tesar and S. Todunoglu.
5. Robot Analysis: The Mechanics of Serial and Parallel Manipulators, by Lung-Wen Tsai, John Wiley & Sons.

ENGINEERING ELECTIVES:

MTE-4xx MODELLING AND SIMULATION

Theory Cr Hrs, 3
Lab Cr Hrs, 0

Course Objectives:

The aim of this course is to introduce students the modeling of mechanical (translatory and rotational) systems, electrical system, electro-mechanical system, fluid system, thermal system and other interdisciplinary system, with conventional modeling and other techniques like Bond Graph and Monte Carlo methods.

Topics Covered:

Modeling of mechanical systems (springs, dampers, mass, translatory and rotational systems, geared systems), Modeling of electrical systems (capacitor, inductor, resistors, and analog electronic devices), Modeling of hydraulic and pneumatic systems, Mechatronics systems (Electro-mechanical, fluid –mechanical and Electro-hydraulic systems), System dynamic response analysis (frequency response),Numerical techniques, time response and digital simulation, stochastic simulation, Monte Carlo methods.

Recommended Books:

1. Modeling and Simulation of Dynamics Systems, Robert L. Woods and Kent L. Lawrence, Prentice-Hall, 1997.
2. Modelling and Simulation of Mechatronics Systems, using Bond Graph theory, Rosenberg.

MTE-4xx FILTER DESIGN AND DIGITAL SIGNAL PROCESSING

Theory Cr Hrs, 3
Lab Cr Hrs, 0

Course Objectives:

To introduce signal processing with an emphasis on digital signal processing and teach the filter design, time-domain and frequency-domain analyses of continuous-time and discrete-time systems. in this course one will also learn When to choose an IIR and when an FIR filter, and How do you design FIR and IIR filters from specifications on amplitude performance?

Topics Covered:

Types of signals; signal representation and models; system characterization; time domain analysis; frequency domain representation and analysis; continuous-time filters; sampled continuous-time signals; Discrete Fourier transform and its properties; Fast Fourier transform algorithms; inverse transform techniques; implementation of discrete-time systems; DSP chip classifications; DSP block diagram; hardware interfacing techniques of DSP; FIR and IIR filter design using DSP; image processing and other practical applications of DSP, and also an introduction to adaptive filter.

Recommended Books:

1. Simon Haykins "Signals and Systems", John Wiley and Sons, USA, 2nd ed. 2003.
2. Rafael Gonzalez and Richard Woods "Digital Signal Processing", Prentice Hall, ISBN: 0201180758, 2nd edition, 2002.

MTE-4xx DIGITAL IMAGE PROCESSING

Theory Cr Hrs, 3
Lab Cr Hrs, 0

Course Objectives:

To develop thorough understanding of digital image processing fundamentals, properties of discrete transforms and their importance, study of various image enhancement techniques in spatial and frequency domains, fundamentals of image compression, introduction to color image processing, wavelets and morphological image processing.

Topics Covered:

Introduction to Digital Image Processing:
Digital Image Representation, Acquisition, Storage, Processing, Communication and Display.

Digital Image Fundamentals:
Visual Perception, Issues in Sampling and Quantization of a digital image, Connectivity and relations between pixels.

Image Enhancement:
Spatial and Frequency Domain methods, Enhancement by point processing, Histogram processing, spatial filtering techniques, Enhancement in Frequency domain, frequency filtering techniques.

Image Transforms:
Discrete Fourier Transform, Properties of 2-D Fourier Transforms, Fast Fourier transform (FFT), Discrete Cosine Transform (DCT).

Image Restoration:
Degradation model, Spatial and frequency domain filtering, inverse filtering, Weiner filters.

Colour Image Processing:
Fundamentals of colour image processing, colour models.

Image Compression:
Types of redundancy, fidelity criterion, study of error free compression and lossy compression techniques; their merits and demerits, Image Compression Standards.

Wavelets & Morphology:
Introduction to wavelets and their application in image compression, some basic morphological algorithms.

Recommended Books:

1. Digital Image Processing by Rafael C. Gonzalez, Richard E. Woods, Addison Wesley, 2ed. 2002.
2. Digital Image Processing by Kenneth R. Castleman, Prentice Hall International Edition, 1996.
3. Digital Image Processing Using Matlab by Rafael C. Gonzalez and Richard E. Woods, Pearson Education, 2004.

MTE-4xx ARTIFICIAL INTELLIGENCE & COMPUTER VISION

Theory Cr Hrs, 2
Lab Cr Hrs, 1

Course Objectives:

To educate the students of BE Mechatronics about Artificial Intelligence (AI), technologies needed for implementing AI, and the logic used in various AI applications like Computer Vision, Robotics, Expert Systems, Natural Language Processing etc.

Topics Covered:

Introduction of AI. Overview of areas of application of AI and the technologies needed for AI. Expert systems development life cycle. Major parts of an Expert System. Expert System Shells. Knowledge Representation Techniques; First Order Logic, Predicate Logic, Temporal Logic, Production Rules, Semantic nets, Frames, OAV triplets. Programming examples of Prolog. Major Parts of a Prolog program. Backtracking ability of Prolog. Search, input and output handling in Prolog. XML as AI programming language. Programming examples of XML. Knowledge management capability of XML. Searching Techniques; Depth-first, Breadth-first, Heuristic

Search etc. Inference Techniques; Forward Chaining, Backward Chaining. Natural Language Processing. Machine Translation. Speech Synthesis and Speech Recognition. Various types of Parsers; Top-down parsing, Bottom-up Parsing. ATN Parsers, Chart Parsers. Handling Uncertainty and Ambiguity.

Overview of Digital Image Processing; image acquisition, image enhancement, thresholding, edge detection, objects recognition, and scene understanding. Image processing techniques for computer vision; FFT, Histogram Analysis and Histogram Equalization, Hough Transform. Pattern matching techniques; Euclidian Distance technique.

Miscellaneous applications of AI in Mechatronics. Robotics, path planning using AI algorithms like A* algorithm, intelligent agents, intelligent machines, automated testing systems, computer vision for real time systems, face recognition, fingerprint recognition. Game Playing / Problem Solving. Introduction to Learning Algorithms; Neural Networks and Genetic Algorithm.

Recommended Books:

1. Mishkoff, H C. “Understanding Artificial Intelligence”, Sams Understanding Series, Howard W. Sams & Co Inc., USA, 2000.
2. Charniak, E & Mcdermott, D. “Introduction to Artificial Intelligence”, Addison-Wesley Longman Inc., USA, 2nd ed.1999.
3. Rafael Gonzalez and Richard Woods “Digital Signal Processing”, Prentice Hall, ISBN: 0201180758, 2nd edition, 2002.

MTE 4xx EMBEDDED SYSTEMS

Theory Cr Hrs, 3
Lab Cr Hrs, 0

Course Objectives:

This course is designed to develop a standalone application using modern embedded devices.

Topics Covered:

Introduction to embedded systems, Hardware architecture for embedded systems: Programmable logic devices like, Programmable array logic (PAL) Programmable logic array (PLA), complex Programming logic device (CPLD), Application Specific Integrated Circuits (ASIC) and Field Programmable Gate Arrays (FPGA). Software for embedded systems: Introduction to development environment: FPGA development kit (Sparton-III), Introduction to Verilog, Development of various applications like Mux, Demux, counters, registers, ALU etc. Development of an image processing system using FPGA.

Recommended Books:

1. Computer Architecture, A Quantitative approach by Dr. David A. Patterson and Dr. Paul Hennessey,- Digital Computer Electronics by Malvino & Brown.
2. Embedded System Design: A unified Hardware/Software Introduction. By Frank Vahid & Tony D. Givarigis.
3. Embedded System Design. Hardware/ Software System, by P. Marwedel
4. FPGA prototyping by VHDL examples: Xilinx Spartan-3 version, By Pong P. Chu - Wiley-Interscience.

MTE-4xx DIGITAL CONTROL

Theory Cr Hrs, 3
Lab Cr Hrs, 0

Course Objectives:

This course covers the basic and advanced theory about the analysis and design of digital control or sampled-data systems as well as use of digital computers in the real time control of dynamic systems. At the end of this course student should be able to analyze the digital and sampled-data system and understand the effects of quantization and sample rate etc.

Topics Covered:

Problem definition, overview of design approach, Review of continuous Control, Introductory Digital Control: Digitization, effect of sampling. Discrete system analysis; Linear difference equations, Discrete transfer function, Block diagram, external stability. Discrete models of sampled-data systems; using z-transform, continuous time delay. Signal analysis and dynamic response; unit impulse, unit step, exponential, general sinusoid, step response, frequency response, Discrete Fourier Transform. z-transform, solution of difference equation, Modified z-transform, properties of z-transform, convergence of z-transform, inversion. Sampled data system; Analysis of sample & hold, spectrum of a sampled signal, block diagram, analysis of sampled-data system, Calculating the system output between samples, Discrete Equivalents; zero-pole matching equivalents, hold equivalents. Design using Transform Techniques; z-domain root locus, z-domain digital controller design, Frequency response methods; Nyquist stability criterion, design specifications in frequency domain, compensator design. Quantization Effects; Analysis of round-off errors, effects of parameter round-off, Sample rate Selection, Sampling Theorem, Sensitivity to parameter variations, multi-rate sampling.

Recommended Books:

1. Digital Control of Dynamic Systems, by Gene F. Franklin, J. David Powell and Michael L. Workman, Addison Wesely, Latest Edition.
2. Digital control Engineering, analysis and design, by M. Sami Fadali and Antonio Visioli, Eslevier Latest Edition.
3. Control System Design using MATLAB, by Bahram Shahian and Michael Hassul, Prentice-Hall Latest Edition.

MTE 4xx POWER PLANTS

Theory Cr Hrs, 2
Lab Cr Hrs, 1

Course Objectives:

This course introduces the power conversion of steam, nuclear and gas turbine cycles and its applications in Mechatronics Engineering.

Topics Covered:

Internal Combustion Engines: Various components and working of IC Engines, Auxiliary systems, Criteria of Performance, Engine Output and Efficiency, Performance characteristics.

Steam Power Plants: Steam Generators; Rankine cycle, Ran kine cycle with superheat, and reheat cycles. The Reciprocating Steam Engines.

Combined Cycle Power Plants: General, Combined Cycle with heat-Recovery Boiler Combined Cycle with Multi Pressure Steam. Steam Cycles for Nuclear Power Plant, Combined Cycle for Nuclear Power Plants..

Gas Turbine Cycles: The Components of Gas Turbine Power Plant, Air Brayton cycle for power plant and for Jet Engines.

Reciprocating and Turbo Machinery: Introduction to Reciprocating Compressors, Centrifugal Compressors, Multi-Stage Compression, Vacuum Pumps, Air Motors. Rot Dynamic Machines for Steam and Gas Turbine Plants; Pumps.

Recommended Books:

1. Fundamentals of Classical Thermodynamics, By Gordon J. Van Wylen and Richard E. Sonntag. Wiley International Edition.
2. Engineering Thermodynamics Work & Heat Transfer, by G. F. C Roges and Y. R. Mayhew, Longman.
3. Fundamentals of Engineering Thermodynamics by Micheal J. Moran and Howard N. Shapiro, John Wiley & Sons.
4. Applied Thermodynamics for Engineering Technologists, By T. D Eastop and A: Mc-Conkey, Longman.
5. Engineering Thermodynamics by Merle C Potter and Craig W. Somerton, McGraw Hill Companies Inc.