

**M**echanical and

**C**hemical

**E**ngineering

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## **General Information**

Mechanical engineering is one of the oldest and broadest disciplines of engineering which implements the principles of physics and materials science for analysis, design, manufacturing and maintenance of mechanical systems. It is also the branch of engineering which incorporates the production and usage of heat and mechanical power for the design, production and operation of tools and machineries. Besides dealing with the core concepts including mechanics, kinematics, thermodynamics, materials science and structural analysis, mechanical engineering employs tools like computer-aided engineering and product lifecycle management to design and analyze manufacturing plants, industrial equipments, heating and cooling systems, vehicles, aircraft, watercraft, robotics, medical devices and many more. Furthermore, this field has continually evolved to incorporate advancements in technology in fields such as composites, mechatronics and nanotechnology. Mechanical engineering also converges with aerospace, civil, electrical and petroleum engineering to varying amounts.

In this context, IUT offers extensive courses both in general and specialized fields of mechanical engineering providing excellent exposure to the graduating students in preparing them for the competitive job fields in both academic and industrial area. Specialized subjects like materials and tool engineering, metal forming, working and fabrication provides widespread understanding in the field of Production Engineering. Furthermore, specialized area like Industrial Instrumentation and Control comprises courses on Engineering System Design, Hydraulic, Pneumatic and Electric Drive Systems, Automatic Control Engineering etc to prepare the students to cope with crucial industrial contexts. Courses on Vehicle Dynamics, Automotive Technology and Maintenance, coupled with Engineering Design, Finite Element Analysis and Electrical and Electronic Engineering provide advanced and indispensable knowledge and skill in the field of Automotive Engineering. Students are also offered courses on Renewable

Energy, Turbomachinery, Advanced Machine Tools Design, Advanced Topics in Manufacturing, Expert Process Planning for Manufacturing, CIM and Database Management System in the postgraduate level.

### **Different Programmes offered by MCE Department**

The Department of Mechanical and Chemical Engineering of the University offers various engineering and technological courses at post-graduate and undergraduate levels. Under the long regular programmes, the Department offers

- **Doctor of Philosophy in Mechanical Engineering**
- **Master of Science in Mechanical Engineering**
- **Master of Mechanical Engineering**
- **Postgraduate Diploma in Mechanical Engineering**
- **Bachelor of Science in Mechanical Engineering**
- **Higher Diploma in Mechanical Engineering**
- **Higher Diploma in Chemical Engineering**

The Doctor of Philosophy in Mechanical Engineering, Master of Science in Mechanical Engineering, Master of Engineering and Postgraduate Diploma in Mechanical Engineering involve varying hours of research, projects, course works requiring 54, 36, 36, 24 credit hours and will normally require 6, 3, 3 and 2 semesters respectively.

The B.Sc. Engineering Course in Mechanical Engineering comprises of four years of study consisting of eight consecutive semesters of sixteen weeks duration each. However, there is a provision for award of Higher Diploma in Mechanical Engineering with specialization in Automotive, CAD/CAM, Energy or Refrigeration & Air-conditioning after successful completion of three years (six semesters) of study. Higher Diploma in Engineering graduates may also continue further for completion of B.Sc. Engineering programme. The admission requirements are Higher/Upper Secondary School Certificate level with science background i.e., university entry

requirements. The total contact hours in classes, laboratories and workshops are 25-30 hours per week. The course curricula contain engineering science of high level as well as include components for hands-on-experience, to produce engineers of international standard having relevance to the development needs of the Member States.

Besides the above programmes, knowledge updating and skill upgrading courses are conducted on regular long term basis for the students of Instructor Training and General Studies Department at various levels starting from Diploma in Vocational Education to the highest Master of Science in Technical Education including Post-Graduate Diploma in Technical Education, Bachelor of Science and Diploma in Technical Education, while on short term basis special training programmes are designed and offered. The course curricula are under constant scrutiny and review and are continuously updated to meet the needs and requirements of the Member States as well as the international standard of the curricula.

The Department is also involved in technological and engineering research as well as in organizing seminars, short courses, symposiums and workshops. Assessment of solar energy in the Islamic World, solar energy utilization, prospects of indigenous low cost construction materials, automation of manufacturing processes, emission from automobiles, vehicle dynamics are some of the research and development projects now being carried out in the Department.

## Course Structure for Undergraduate Programmes in Mechanical Engineering

L = Lecture, P = Practical

### First Semester

Course Number	Course Title	Contact Hours	Credit Hours
		<b>L - P</b>	
Math 4103	Mathematics I	3 - 0	3.00
Phy 4103	Physics I	3 - 0	3.00
Phy 4104	Physics I Lab	0 - 3/2	0.75
Chem 4103	Chemistry	3 - 0	3.00
Chem 4104	Chemistry Lab	0 - 3/2	0.75
MCE 4191	Computer Programming and Applications	2 - 0	2.00
MCE 4192	Computer Programming and Applications Lab	0 - 3	1.50
MCE 4108	Mechanical Engineering Drawing-I	0 - 3	1.50
MCE 4110	Workshop Practice I	0 - 3	1.50
ITS 0102	Spoken Arabic I	0 - 2	1.00
	or		
ITS 0104	Spoken English I		
	or		
ITS 0106	Spoken French I		
ITS 0107	Islamiat	2 - 0	2.00
ITS 4149	Technology, Environment and Society	3 - 0	3.00
	Total L-P	16-14	
	<b>Total Hours</b>	<b>30.00</b>	<b>23.00</b>

## Second Semester

Course Number	Course Title	Contact Hours	Credit Hours
		<b>L - P</b>	
Math 4203	Mathematics II	3 - 0	3.00
Phy 4203	Physics II	3 - 0	3.00
Phy 4204	Physics II Lab	0 - 3/2	0.75
Chem 4203	Chemistry of Engg. Materials	2 - 0	2.00
Chem 4204	Chemistry of Engg. Materials Lab	0 - 3/2	0.75
MCE 4203	Engineering Mechanics - I	3 - 0	3.00
MCE 4204	Engineering Mechanics I- Lab	0 - 3/2	0.75
MCE 4208	Mechanical Engineering Drawing - II	0 - 3	1.50
MCE 4210	Workshop Practice II	0 - 3	1.50
MCE 4225	Metallurgy	2 - 0	2.00
MCE 4226	Metallurgy Lab	0 - 3/2	0.75
ITS 0202	Spoken Arabic II or	0 - 2	1.00
ITS 0204	Spoken English II or		
ITS 0206	Spoken French II		
ITS 0207	Islamic History and Culture	3 - 0	3.00
	Total L-P	16-14	
	<b>Total Hours</b>	<b>30.00</b>	<b>23.00</b>

### Third Semester

Course Number	Course Title	Contact Hours	Credit Hours
		<b>L - P</b>	
Math 4303	Mathematics III	4 - 0	4.00
MCE 4303	Engineering Mechanics - II	3 - 0	3.00
MCE 4304	Engineering Mechanics-II Lab	0 - 3/2	0.75
MCE 4305	Thermodynamics - I	3 - 0	3.00
MCE 4306	Thermodynamics Lab - I	0 - 3/2	0.75
MCE 4311	Fluid Mechanics - I	3 - 0	3.00
MCE 4312	Fluid Mechanics Lab - I	0 - 3/2	0.75
MCE 4321	Manufacturing Processes	3 - 0	3.00
MCE 4322	Manufacturing Process Practices	0 - 3/2	0.75
EEE 4325	Electrical and Electronic Technology - I	3 - 0	3.00
EEE 4326	Electrical and Electronic Technology Lab-I	0 - 3/2	0.75
	Total L – P	19-7½	
	<b>Total Hours</b>	<b>26.50</b>	<b>22.75</b>



### Fourth Semester

Course Number	Course Title	Contact Hours	Credit Hours
		<b>L - P</b>	
Math 4403	Mathematics IV	3 - 0	3.00
Math 4404	Mathematics Practice-IV	0 - 3/2	0.75
MCE 4405	Thermodynamics II	3 - 0	3.00
MCE 4406	Thermodynamics Lab - II	0 - 3/2	0.75
MCE 4407	Instrumentation & Measurements	2 - 0	2.00
MCE 4408	Instrumentation & Measurements Lab	0 - 2	1.00
MCE 4411	Fluid Mechanics II	3 - 0	3.00
MCE 4412	Fluid Mechanics II Lab	0 - 3/2	0.75
MCE 4413	Heat Transfer	3 - 0	3.00
MCE 4414	Heat Transfer Lab	0 - 3/2	0.75
EEE 4425	Electrical and Electronic Technology - II	3 - 0	3.00
EEE 4426	Electrical and Electronic Technology Practice - II	0 - 3/2	0.75
ITS 4472	Technical Report Writing	0 - 2	1.00
	Total L – P	17-11½	
	<b>Total Hours</b>	<b>28.50</b>	<b>22.75</b>

### Fifth Semester

<b>Course Number</b>	<b>Course Title</b>	<b>Contact Hours</b>	<b>Credit Hours</b>
		<b>L - P</b>	
MCE 4503	Mechanics of Materials	4 - 0	4.00
MCE 4504	Mechanics of Materials Lab	0 - 3/2	0.75
MCE 4505	Fluid Machinery	3 - 0	3.00
MCE 4506	Fluid Machinery Lab	0 - 3/2	0.75
MCE 4507	Control and Automation	2 - 0	2.00
MCE 4508	Control and Automation Lab	0 - 2	1.00
MCE 4531	Statistics and Quality Control	3 - 0	3.00
MCE 4532	Statistics and Quality Control Lab	0 - 2	1.00
Elective/Specialization Subjects -		6 - 0	6.00
	2 Theories + 2 Lab/Practices	0 - 3	1.50
	Total L – P	18+10	
	<b>Total Hours</b>	<b>28.00</b>	<b>23.00</b>

## Sixth Semester

Course Number	Course Title	Contact Hours	Credit Hours
		<b>L - P</b>	
MCE 4603	Mechanics of Machines	3 - 0	3.00
MCE 4604	Mechanics of Machines Lab	0 - 3/2	0.75
MCE 4627	Machine Tools	2 - 0	2.00
MCE 4628	Machine Tools Practice	0 - 2	1.00
MCE 4639	Machine Design - I	3 - 0	3.00
MCE 4640	Machine Design Practice - I	0 - 2	1.00
ITS 4649	Social Studies and Accounting	3 - 0	3.00*
	Elective/Specialization Subjects - 2 Theories	6 - 0	6.00
	2 Lab/Practices	0 - 3	1.50
	Total L – P	17-8.5	
	<b>Total Hours</b>	<b>25.50</b>	<b>21.25</b>

\***Note:** Students completing Higher Diploma in Mechanical Engineering (HDME) which is integrated with B.Sc. Engg. (Mech) Programme, are required:

- (1) To undertake a Industrial Training Programme MCE 4590 of 1 credit hour organized by IUT during the session break in between 4th and 5th semester. Duration of the training programme will be about four weeks;
- (2) To undertake project work, MCE 4500 Project and Report (0-6) of 3 Semester Credit hours;
- (3) To take in the sixth semester MCE 4629 Engineering Management (3-0) instead of ITS 4649 Social Studies and Accounting which is taken by B.Sc. Engg. student.

## Seventh Semester

<b>Course Number</b>	<b>Course Title</b>	<b>Contact Hours</b>	<b>Credit Hours</b>
		<b>L - P</b>	
MCE 4700	Project and Thesis I	0 - 6	3.00
MCE 4705	Thermodynamics - III	3 - 0	3.00
MCE 4711	Fluid Mechanics -III	3 - 0	3.00
MCE 4717	Engineering Economy	2 - 0	2.00
MCE 4739	Machine Design II	3 - 0	3.00
MCE 4740	Machine Design Practice - II	0 - 2	1.00
*MCE 4790	Industrial Training		1.00
MCE 4780	Mechanical Engineering Lab-I	0 - 3	1.50
ITS 4749	Science, Technology and Islam	2 - 0	2.00
	Elective Subject		
	One Theory	3 - 0	3.00
	Total L – P	16-11	
	<b>Total Hours</b>	<b>27.00</b>	<b>22.50</b>

\* This Training Programme will be organized by IUT during the session break in between 6th and 7th Semester and is compulsory for all the students of MCE. Duration of the Training Programme will be about four weeks.

## Eighth Semester

Course Number	Course Title	Contact Hours	Credit Hours
		<b>L - P</b>	
MCE 4800	Project and Thesis II	0 - 6	3.00
MCE 4803	Vibration and System Dynamics	3 - 0	3.00
MCE 4805	Power Plant Engineering	3 - 0	3.00
MCE 4827	Production Planning and Control	3 - 0	3.00
MCE 4880	Mechanical Engineering Lab - II	0 - 3	1.50
MCE 4813	Heat and Mass Transfer	3 - 0	3.00
MCE 4829	Industrial Management	3 - 0	3.00
	Elective subject One Theory	3 - 0	3.00
	Total L-P	18-9	
	<b>Total Hours</b>	<b>27.00</b>	<b>22.50</b>
	<b>Grand Total:</b>	<b>222.50</b>	<b>180.75</b>

## Elective/Specialisation Courses

### Fifth and Sixth Semester

#### Production Engineering

Course Number	Course Title	Contact Hours	Credit Hours
		<b>L - P</b>	
MCE 4521	Materials Engineering	3 - 0	3.00
MCE 4522	Materials Engineering Lab	0 - 3/2	0.75
MCE 4523	Metal Forming and Fabrication	3 - 0	3.00
MCE 4524	Metal Forming and Fabrication Lab	0 - 3/2	0.75
MCE 4621	Tool Engineering	3 - 0	3.00
MCE 4622	Tool Engineering Lab	0 - 3/2	0.75
MCE 4625	Theory of Metal Working	3 - 0	3.00
MCE 4626	Theory of Metal Working Lab	0 - 3/2	0.75

#### Design and Drafting

Course Number	Course Title	Contact Hours	Credit Hours
		<b>L - P</b>	
MCE 4521	Materials Engineering	3 - 0	3.00
MCE 4522	Materials Engineering Lab	0 - 3/2	0.75
MCE 4533	Engineering System Design	3 - 0	3.00
MCE 4534	Engineering System Design Lab	0 - 3/2	0.75
MCE 4537	Computer Aided Design	3 - 0	3.00
MCE 4538	Computer Aided Design Lab	0 - 3/2	0.75
MCE 4621	Tool Engineering	3 - 0	3.00
MCE 4622	Tool Engineering Practice	0 - 3/2	0.75
MCE 4625	Theory of Metal Working	3 - 0	3.00
MCE 4626	Theory of Metal Working Lab	0 - 3/2	0.75

## CAD/CAM

<b>Course Number</b>	<b>Course Title</b>	<b>Contact Hours</b>	<b>Credit Hours</b>
		<b>L - P</b>	
MCE 4521	Materials Engineering	3 - 0	3.00
MCE 4522	Materials Engineering Lab	0 - 3/2	0.75
MCE 4543	Graphics Programming and Design	3 - 0	3.00
MCE 4544	Graphics Programming and Design Practice	0 - 3/2	0.75
MCE 4547	Computer Aided Design and Manufacturing	3 - 0	3.00
MCE 4548	Computer Aided Design and Manufacturing Practice	0 - 3/2	0.75
MCE 4621	Tool Engineering	3 - 0	3.00
MCE 4622	Tool Engineering Practice	0 - 3/2	0.75
MCE 4625	Theory of Metal Working	3 - 0	3.00
MCE 4626	Theory of Metal Working Lab	0 - 3/2	0.75

## Refrigeration and Air-conditioning

<b>Course Number</b>	<b>Course Title</b>	<b>Contact Hours</b>	<b>Credit Hours</b>
		<b>L - P</b>	
MCE 4551	Refrigeration	3 - 0	3.00
MCE 4552	Refrigeration Lab	0 - 3/2	0.75
MCE 4555	Control System Technology	3 - 0	3.00
MCE 4556	Control System Technology Lab	0 - 3/2	0.75
MCE 4651	Plant Operation and Maintenance	3 - 0	3.00
MCE 4652	Plant Operation and Maintenance Practice	0 - 3/2	0.75
MCE 4653	Air-conditioning	3 - 0	3.00
MCE 4654	Air-conditioning Practice	0 - 3/2	0.75

## Industrial Instrumentation and Control

Course Number	Course Title	Contact Hours	Credit Hours
		<b>L - P</b>	
MCE 4533	Engineering System Design	3 - 0	3.00
MCE 4534	Engineering System Design Lab	0 - 3/2	0.75
MCE 4561	Instrumental Methods of Analysis	3 - 0	3.00
MCE 4562	Instrumental Methods of Analysis Lab	0 - 3/2	0.75
MCE 4661	Hydraulic, Pneumatic and Electric Drive Systems	3 - 0	3.00
MCE 4662	Hydraulic, Pneumatic and Electric Drive Systems Lab	0 - 3/2	0.75
MCE 4663	Automatic Control Engineering	3 - 0	3.00
MCE 4664	Automatic Control Engineering Lab	0 - 3/2	0.75

## Energy

Course Number	Course Title	Contact Hours	Credit Hours
		<b>L - P</b>	
MCE 4573	Renewable Energy Resources	3 - 0	3.00
MCE 4574	Renewable Energy Resources Lab	0 - 3/2	0.75
EEE 4551	Utilisation of Electrical Energy I	3 - 0	3.00
EEE 4552	Utilisation of Electrical Energy Lab I	0 - 3/2	0.75
MCE 4671	Fossil Fuel Engineering	3 - 0	3.00
MCE 4672	Fossil Fuel Engineering Lab	0 - 3/2	0.75
EEE 4651	Utilisation of Electrical Energy II	3 - 0	3.00
EEE 4652	Utilisation of Electrical Energy Lab II	0 - 3/2	0.75



## Automotive Engineering

Course Number	Course Title	Contact Hours	Credit Hours
		<b>L - P</b>	
MCE 4585	Automotive Technology - I	3 - 0	3.00
MCE 4586	Automotive Technology Practice I	0 - 3/2	0.75
MCE 4587	Automotive Maintenance Engineering I	3 - 0	3.00
MCE 4588	Automotive Maintenance Engineering Practice-I	0 - 3/2	0.75
MCE 4685	Automotive Technology II	3 - 0	3.00
MCE 4686	Automotive Technology Practice II	0 - 3/2	0.75
MCE 4687	Automotive Maintenance Engineering II	3 - 0	3.00
MCE 4688	Automotive Maintenance Engineering Practice-II	0 - 3/2	0.75

## Elective Subjects

### Seventh Semester

Course Number	Course Title	Contact Hours	Credit Hours
		<b>L - P</b>	
MCE 4721	Manufacturing System and Automation	3 - 0	3.00
MCE 4725	Machine Maintenance Engineering	3 - 0	3.00
MCE 4735	Advance Drafting	3 - 0	3.00
MCE 4745	Computer Aided Numerical Controlled Manufacturing	3 - 0	3.00
MCE 4751	Air-Conditioning System Engineering	3 - 0	3.00
MCE 4761	Control System Instrumentation	3 - 0	3.00
MCE 4771	Energy Conservation and Management	3 - 0	3.00
MCE 4787	Automobile Engg	3 - 0	3.00

### Eighth Semester

Course Number	Course Title	Contact Hours	Credit Hours
		<b>L - P</b>	
MCE 4821	Design for Manufacturing	3 - 0	3.00
MCE 4823	Operations Research	3 - 0	3.00
MCE 4835	Linkage and Motion	3 - 0	3.00
MCE 4839	Mechatronics	3 - 0	3.00
MCE 4845	Robotics and Computer Integrated Manufacturing System	3 - 0	3.00
MCE 4873	Solar Energy Conversion	3 - 0	3.00
MCE 4887	Fundamentals of Road Vehicle Dynamics	3 - 0	3.00

## POST GRADUATE PROGRAMMES

The postgraduate programmes of Mechanical Engineering i.e., M Sc Engg, M Engg and Postgraduate Diploma the following courses are offered. The requirements of credit hours for the different programmes are given in the section of general information.

### LIST OF COURSES

MCE 6100	Project
MCE 6200	Thesis
Math 6103	Advanced Mathematics
MCE 6103	Theory of Elasticity
MCE 6105	Mechanical Behaviour of Materials
MCE 6107	Experimental Stress Analysis
MCE 6109	Mechanical Vibrations
MCE 6115	Inviscid Fluid Flow
MCE 6117	Viscous Fluid Flow
MCE 6119	Turbomachinery
MCE 6121	Advanced Topics in Manufacturing
MCE 6123	Expert Process Planning for Manufacturing
MCE 6125	CIM and Database Management System
MCE 6127	Advanced Machine Tools Design
MCE 6145	Convective Heat Transfer
MCE 6147	Statistical Thermodynamics
MCE 6153	Boiling and Condensation Heat Transfer
MCE 6161	Advanced Automatic Control
MCE 6201	Engineering Plasticity
MCE 6207	Theory of Plates and Shells
MCE 6209	Finite Element Method
MCE 6213	Turbulence
MCE 6221	Quality Assurance and Management
MCE 6223	Advanced Operations Research
MCE 6225	Engineering Decision Analysis
MCE 6229	Reliability Engineering and System Safety
MCE 6241	Renewable Energy
MCE 6243	Combustion Process
MCE 6250	Special Topics
MCE 6321	Design management & prediction

MCE 6323	Design Methodology, Techniques & Tools
MCE 6325	CAD and Product Data Management
MCE 6327	Modelling, simulation, and visualization
MCE 6329	Digital manufacture and rapid manufacture
MCE 6351	Advanced Heat Transfer and Computational Fluid Dynamics (CFD)
MCE 6421	Robotics and Manufacturing Automation
MCE 6423	Materials design and materials processing
MCE 6425	Advanced laser processing
MCE 6427	Process planning & Computer Aided Manufacturing (CAM)
MCE 6429	Design Optimization and Analysis

## Course Structure for Higher Diploma in Chemical Engineering

L = Lecture, P = Practical

### First Semester

Course Number	Course Title	Contact Hours	Credit Hours
<b>L - P</b>			
Math 4103	Mathematics-I	3 – 0	3.00
Phy 4103	Physics – I	3 – 0	3.00
Phy 4104	Physics Lab – I	0 – 3/2	0.75
Chem 4103	Chemistry	3 – 0	3.00
Chem 4104	Chemistry Lab	0 – 3/2	0.75
MCE 4191	Computer Programming and Application	2 – 0	2.00
MCE 4192	Computer Programming and Application Lab	0 – 3	1.50
MCE 4108	Mechanical Engineering Drawing I	0 – 3	1.50
ITS 0102	Spoken Arabic	0 – 2	1.00
	Or		
ITS 0104	Spoken English		
	Or		
ITS 0106	Spoken French		
ITS 0107	Islamiat	2 – 0	2.00
ITS 4149	Technology, Environment and Society.	3 – 0	3.00
Total L- P		16.0-11.0	
<b>Total Hours</b>		<b>27.00</b>	<b>21.50</b>

## Second Semester

Course Number	Course Title	Contact Hours	Credit Hours
		<b>L - P</b>	
MChE 4207	Elements of Chemical	3 - 0	3.00
Math 4203	Engineering	3 - 0	3.00
Phy 4203	Physics – II	3 - 0	3.00
Phy 4204	Physics Lab – II	0–3/2	0.75
Chem 4203	Chemistry of Engineering Materials	3 - 0	3.00
Chem 4204	Chemistry of Engineering Materials Lab	0 – 3/2	0.75
MCE 4203	Engineering Mechanics-I	3 - 0	3.00
MCE 4204	Engineering Mechanics Lab-I	0 – 3/2	0.75
MCE 4220	Workshop Practice	0 - 3	1.50
ITS 0202	Spoken Arabic – II or	0 – 2	1.00
ITS 0204	Spoken English – II or		
ITS 0206	Spoken French – II		
ITS 0207	Islamic History and Culture	2 – 0	2.00
	Total L- P	17.0 –9.50	
	<b>Total Hours</b>	<b>26.50</b>	<b>21.75</b>

### Third Semester

Course Number	Course Title	Contact Hours	Credit Hours
		<b>L – P</b>	
Math 4303	Mathematics – III	4 - 0	4.00
Chem 4307	Physical Chemistry	3 – 0	3.00
Chem 4308	Physical Chemistry Lab	0 – 3	1.50
MChE 4341	Material and Energy Balance	3 – 0	3.00
MChE 4342	Material & Energy Balance Lab	0 – 3	1.50
MCE 4305	Thermodynamics – I	3 – 0	3.00
MCE 4306	Thermodynamics Lab-1	0 – 3/2	0.75
MCE 4311	Fluid Mechanics-1	3 – 0	3.00
MCE 4312	Fluid Mechanics Lab-II	0 – 3/2	0.75
EEE 4325	Electrical and Electronic Technology	3 – 0	3.00
EEE 4326	Electrical and Electronic Technology Lab.	0 – 3/2	0.75
	Total L- P	19.0 – 10.50	
	<b>Total Hours</b>	<b>29.50</b>	<b>24.25</b>

### Fourth Semester

Course Number	Course Title	Contact Hours	Credit Hours
		<b>L - P</b>	
Math 4403	Mathematics – IV	3 – 0	3.00
Math 4404	Mathematics – IV Lab	0 – 3/2	0.75
Chem 4407	Organic Chemistry	3 – 0	3.00
Chem 4408	Organic Chemistry Lab	0 – 3	1.50
MCE 4411	Fluid Mechanics –II	3 – 0	3.00
MCE 4412	Fluid Mechanics Lab – II	0–3/2	0.75
MCE 4413	Heat Transfer	3 – 0	3.00
MCE 4414	Heat Transfer Lab	0–3/2	0.75
MCE 4407	Instrumentation and Measurements	2 – 0	2.00
MCE 4408	Instrumentation and Measurements Lab	0 – 2	1.00
MCE 4405	Thermodynamics – II	3 – 0	3.00
MCE 4406	Thermodynamics Lab-II	0 – 3/2	0.75
ITS 4472	Technical Report Writing	0 – 2	1.00
	Total L- P	17.0-13.0	23.5
	<b>Total Hours</b>	<b>30.00</b>	



### Fifth Semester

Course Number	Course Title	Contact Hours	Credit Hours
		<b>L – P</b>	
MChE 4501	Separation Process I	3 – 0	3.00
MChE 4502	Separation Process Lab I	0 – 3/2	0.75
MCE 4505	Fluid Machinery	3 – 0	3.00
MCE 4506	Fluid Machinery Lab	0 – 3/2	0.75
MCE 4507	Control and Automation	2 – 0	2.00
MCE 4508	Control and Automation Lab	0 – 3/2	0.75
Chem 4509	Instrumental Methods	3 – 0	3.00
MChE 4590	Industrial Training		1.00
MChE 4506	Chemical Equipment Maintenance Lab	0 – 3	1.50
Specialization Subjects	2 theories	6 – 0	6.00
	2 lab/practices	0 – 3	1.50
	Total L- P	17.0–10.5	
	<b>Total Hours</b>	<b>27.50</b>	<b>23.25</b>

### Sixth Semester

<b>Course Number</b>	<b>Course Title</b>	<b>Contact Hours L – P</b>	<b>Credit Hours</b>
MChE 4601	Separation Process II	3 – 0	3.00
MChE 4602	Separation Process Lab II	0 – 3/2	0.75
MChE 4603	Reaction Engineering	3 – 0	3.00
MChE 4604	Reaction Engineering Lab	0 – 3	1.50
MChE 4623	Plant Design & Economics	2 – 0	2.00
MCE 4629	Engineering Management	3 – 0	3.00
MChE 4600	Project	0 – 6	3.00
Specialization	2 theories	6 – 0	6.00
Subjects	2 Lab/ Practices	0 – 3	1.50
Total L- P		17.0-13.5	
<b>Total Hours</b>		<b>30.50</b>	<b>23.75</b>

**Fifth and Sixth Semester  
Specialization: Chemical Process Plants**

<b>Course Number</b>	<b>Course Title</b>	<b>Contact Hours</b>	<b>Credit Hours</b>
		<b>L – P</b>	
MChE 4503	Polymer Chemistry and Petrochemical Technology	3 – 0	3.00
MChE 4504	Polymer Chemistry and Petrochemical Technology Lab	0 – 3/2	0.75
MChE 4509	Fertilizer, Pulp and Paper Technology	3 – 0	3.00
MChE 4510	Fertilizer, Pulp and paper Technology Lab	0 – 3/2	0.75
MChE 4621	Corrosion and Protection of metals	3 – 0	3.00
MChE 4622	Corrosion and Protection of metals Lab	0 – 3/2	0.75
MChE 4607	Pollution and its Control	3 – 0	3.00
MChE 4608	Pollution and its Control Lab	0 – 3/2	0.75
	Total L- P	17.0-13.5	
	<b>Total Hours</b>	<b>30.50</b>	<b>23.75</b>

## Course Contents for Undergraduate Programmes

**Math 4103          Mathematics I          3-0                          Credit 3.00**

**Solid Geometry:** Brief review of two dimensional geometry.

**System of Coordinates:** Direction cosines, equation of planes, angles, perpendicular distances, coplanar lines, shortest distance etc. Area and volume of different solid bodies. Equations of sphere, paraboloid, ellipsoide, hyparaboloid, cone and cylinder and also polar form.

**Vector Algebra:** Scalar, vector and their representation to physical quantities. Dot and cross products and their application. Triple and multiple product.

**Differential Calculus:** Definition and concept of limit, continuity and differentiability of function. Differentiation of different functions. Successive differentiation. Expansion of function by different theorems, Tangent and normal. Maxima and minima. Determination of curvature and their properties. Curve tracing. Partial differentiation.

**Phy 4103          Physics I                          3-0                          Credit 3.00**

### **Waves and Oscillations**

Simple Harmonic Motion, Damped and forced oscillations, Combination of simple harmonic motions, Lissajou's figures, Progressive wave motion, Phase velocity and group velocity, Velocity of sound, Stationary waves, Audible, ultrasonic and supersonic sound, Doppler effect, Architectural acoustics, Noise pollution.

### **Optics**

Combination of lenses, defects of image, Spherical and chromatic aberrations. Optical instruments, Interference of light, Huygens principle, Young's double slit experiment, Fresnel bi-prism, Newton's rings, Diffraction of light, Diffraction at single and double slit, Polarization of light, Production and analysis of polarized light, Optical activity and specific rotation.

### **Heat**

Measurement of high temperatures, Kinetic theory of gases, Law of equipartition of energy, degrees of freedom of a gas, Mean free path of a gas molecule, Van der waal's equation, Critical constants of a

gas, Specific heats of gases, Reversible and irreversible processes, Carnot cycle, Second law of thermodynamics, Carnot's theorem, Entropy.

**Phy 4104      Physics I Lab      0-3/2      Credit 0.75**

Laboratory Experiments and studies based on Phy 4103

**Chem 4103      Chemistry:      3 – 0      Credit 3.00**

**Inorganic Chemistry:**

Atomic Structure, isotopes, quantum numbers, periodic table, classification of elements, noble gases and their general properties, modern concept of acids and bases, chemical bond; its types and properties, different types of chemical reactions.

**Physical Chemistry:**

**Thermochemistry:** heat of reaction and its variation with temperature, enthalpy, heat of combustion, heat of neutralization, Chemical equilibrium: its characteristics, law of mass action, types of equilibrium constants. Le-chatelier principle, ionic equilibrium; ionisation of water, concept of pH, solution; its types, Solubility: process of dissolution, solution of gases in liquids, distribution law; properties of dilute solution; lowering of vapour pressure, Raoult's law, elevation of boiling point, depression of freezing point, osmotic pressure, Chemical Kinetics: rate, order and molecularity of chemical reaction, Colloids and colloidal system, Phase rule; Gibb's rule; Electrochemistry, electrolytes, mechanism of electrolytic conduction; transport number and electrolytic conductance.

**Chem 4104      Chemistry Lab      0 - 3/2      Credit 0.75**

Laboratory Experiments and studies based on Chem 4103.

**MCE 4191      Computer Programming      2-0      Credit 2.00  
   and Applications**

Introduction to computers and programming languages, Introduction to C and C++ Programming Language, Programming Exercises. Calculations using MATLAB.

**MCE 4192      Computer Programming and Applications Practice Lab      0-3      Credit 1.50**

Solving of problems through Computer Programming using micro-computers and workstations.

**MCE 4108 Mechanical Engineering Drawing-I      0-3      Credit 1.50**

Introduction of Engineering Drawings, alphabet of lines, drawing instruments and their uses, geometrical construction, drawing of geometrical figures, exercising tangents.

Orthographic drawing; Views, arrangement of views in first angle and third angle, Projection Exercise on views by straight and taper surfaced simple block.

Isometric and oblique projections: isometric and oblique drawings of simple figures

Practice on lettering and numerals; lettering exercising on a composition.

Sectioning; Full section, scales of drawings, Dimensioning.

**MCE 4110 Workshop Practice - I      0-3      Credit 1.50**

Workshop safety and safety rules. Filing practice: rectangular block filing and curve filing. Turning practice: facing, centre drilling, plain turning, step turning, drilling and boring in centre lathe. Drilling practice: layout and marking of hole centers, drilling, counterboring, counter sinking, reaming and tapping. Arc welding practice: Manual metal arc welding technique, bead welding, butt joint and lap joint welding.

**Math 4203      Mathematics II      3-0      Credit 3.00**

**Integral calculus:** Formal definition of integration. Determination of the standard formulae for the integration of algebraic and transcendental functions. Method of substitution, partial fraction, integration by parts, and successive reduction. Definite integral and its application to summation of series. Improper integral. Application of integration in the determination of length of arc of a curve, area under a curve and area enclosed by two curves and volume of solid of revolution by Disc method and Shell method. Determination of

centroids, centres of mass, moment of inertia and second moment of inertia.

**Ordinary differential equation:** Preliminary idea of differential equation formation of differential equation, concept of degree and solution and arbitrary constants, solution of different types of first order first degree differential equation and its application in engineering problems. Solution of second and higher order differential equation with constant coefficients and their application. Solution of differential equation by the method based on factorization of the operator. Solution of linear differential equation with variable coefficients. Infinite series and its convergency and divergency.

**Phy 4203      Physics II    3-0                  Credit 3.00**

**Electricity and Magnetism**

Electric charge, Coulomb's law, electric field and electric field strength, Electric dipole, Gauss' law, Electric potential, Capacitance, Dielectrics and Gauss' law, Current electricity, Magnetic effect of current, Magnetic induction, Magnetic force on moving charges, Torque on a current carrying loop, Biot and Savart's law, Ampere's law, Faraday's laws of electro-magnetic induction, Lenz's law, Magnetic properties of matter.

**Modern Physics**

Special theory of relativity, Michelson-Morley experiment, Lorentz transformations, Consequence of special theory of relativity, Mass-energy relation, Photo-electric effect, Compton effect, Dual aspect of matter, de-Broglie waves, Schrodinger equation, Radioactivity, Atomic nucleus, Alpha, beta and gamma rays.

**Structure of Matter**

State of Matter, Classification of solids, Different types of bonds in Solids, X-rays, X-ray diffraction-Bragg's law, Metal, insulator and semi-conductor, Statistical mechanics.

**Phy 4204      Physics II Lab    0-3/2                  Credit 0.75**

Laboratory Experiments and Studies based on Phy 4203

**Chem 4203    Chemistry of Engineering                          3- 0                          Credit 3.00**  
**Materials**

Chemical treatments of boiler feed water and water for other industrial applications,

Corrosion and its control; definition, classification, importance, various forms, theories of corrosion, bimetallic corrosion, stray current corrosion, corrosion control; by design, material selection, inhibitors, Cathodic protection, applying various coatings; Classification of engineering materials; their different properties, composite materials, structure of solids; types of solids, crystal structure, different crystal systems, packing of atoms, solid state defects; Insulator, semiconductor. Cement: types, portland cement, raw materials, methods of manufacture, setting and hardening, Glass: properties of glass, raw materials, methods of manufacture, chemical reactions in furnace, some special glasses. Ceramics: classification, properties, raw materials, manufacturing process; Refractories: definition, classifications, characteristics, raw materials, fire clay bricks, its manufacture and uses; Lubricants: functions, classification, Polymer: classification, different polymerization processes, important plastics and their uses; Natural and synthetic rubber; compounding of rubber, vulcanization.

**Chem 4204      Chemistry of Engineering      0-3/2      Credit 0.75**  
**Materials Lab**

Laboratory Experiments, studies and visits to industrial units based on Chem 4203.

**MCE 4203      Engineering Mechanics I      3- 0      Credit 3.00**

Dimensions and Units, Newtons Laws of Motion.  
 Force vector, resultant and components of forces, triangle, parallelogram and polygon of forces, Equilibrium of Forces: Free-body diagrams, Equilibrium of particle. Equivalent Force Systems, Moment of Force, Couple. Coplanar force systems, Three dimensional force systems. Equilibrium of Rigid Body. Centroid and Centre of Gravity, Centroid of Composite Bodies, Theorems of Pappus and Guldinus. Centre of pressure. Moments of Inertia of Areas and Masses, Radius of Gyration, Parallel Axis Theorem, Moment of Inertia about inclined axis. Moments of Inertia of Composite Areas and Masses.  
 Force analysis in Trusses and Structures: Method of Joints and Sections. Graphical Solution, Cables.  
 Friction: Laws of Friction, Coefficients, Angle of Repose, Belt traction, Friction in screw jack, efficiency, Pivot and collar friction.

**MCE 4204      Engineering Mechanics I Lab      0- 3/2      Credit 0.75**

Laboratory Experiments and studies based on MCE 4203.



**MCE 4208      Mechanical Engineering      0-3      Credit 1.50**  
**Drawing-II**

Surface Development: Surface development of geometrical solids Cylinder, Prism, Cone, Pyramid, Truncated objects and transition pieces (90 elbow and square to round transition piece) Intersection and Development of 90 Tee.

Freehand Sketching: Freehand Sketch of simple machine parts. Detail parts drawing from assembly drawing with Abbreviations, Symbols, surface finish Fits and Tolerance and title block. Assembly drawing from detail part drawings including bill of materials. Construction of Cam Graphs : Plate cam with roller follower, Plate cam with flat follower. Introduction to CAD and CAD Practice Electrical and Electronic Drawing, Conventional representations of electrical and electronic components.

**MCE 4210      Workshop Practice - II      0- 3      Credit 1.50**

Turning practice: Internal, external and taper turning, Internal and external thread cutting.

Shaping Practice: rectangular block shaping, vertical shaping and angular shaping.

Milling practice: rectangular block milling, step milling and angular milling.

Fabrication practice: shearing, bending, seam joint, soldering.

Gas welding practice: Brazing, leftward, rightward, butt and corner joint welding.

Casting Practice: Moulding and core-making; metal melting, pouring.

**MCE 4225      Metallurgy      2- 0      Credit 2.00**

Introduction, Pig Iron Production from ore, Different Furnaces, iron and plain carbon steels, classification and uses of plain carbon steels. Thermal Equilibrium diagram, Fe-C Diagram; Heat treatment of steels, T-T-T curves, alloy, steels, stainless steels, cast irons, non ferrous metals and alloys, Creep, Fatigue.

**MCE 4226      Metallurgy Lab      0- 3/2      Credit 0.75**

Lab experiments based on MCE 4225.

**MChE 4207 Elements of Chemical Engineering 3- 0 Credits 3.00**

Scope of chemical engineering. Principle of chemical engineering calculations. Process variables, basis of calculations conservation of mass and momentum. Material balance, recycle and bypass. Simple reaction systems. Rheological properties of solution. Chemical equilibria, Law of mass action, activity and activity coefficient, partial molal quantities and chemical potential. Classification of iron and thermal equilibrium diagram. Concept of process design related to chemical engineering.

**Chem 4307 Physical Chemistry 3-0 Credit 3.00**

Wave nature of election. Molecular structure. Application and stability of complex compound. Surface chemistry and catalysis. Molecular spectroscopy: Rotational, vibrational and electronic spectra of molecules. Phase equilibria for two component systems. Electrical properties of solution. Ionic attraction theory. Electro-chemical cell. Buffer solution, its preparation and application. Photo-chemistry. Properties of colloid and macro-molecular solution.

**Chem 4308 Physical Chemistry Lab 0-3/2 Credit 0.75**

Partition co-efficient. Equilibrium constant by distribution method; heat of reaction by calorimetry; Heat of solution by solubility measurement. Viscosity measurement. Determination of specific rate constant. Measurement of equivalent conductance and solubility of sparingly soluble salt.

**Math 4303 Mathematics - III 4- 0 Credit 4.00**

**Vector Calculus:** Formal definition of differentiation and integration and their elementary application to geometry and mechanics. Scaler point function and vector point function. Definition and physical interpretation of gradient of scaler function, divergence and curl of a vector function. Various formula. Theorems of Gauss. Green ans stokes.

**Partial differential equations:** Introduction, Equation of the linear and nonlinear first order. Standard forms. Linear equations of higher order. Equations of the second order with variable coefficients.

**Numerical Analysis:** Concept of Simple difference and divided difference and their relation. Newtons forward and backward interpolation formula. General interpolation formula of Newtons and

Lagrange. Lagrange's inverse interpolation formula. Inverse interpolation by successive approximation. Numerical differentiation. Numerical integration. General quadrature formula for equidistant ordinates. Simpson's rule, Weddles rule, Trapezoidal rule and their comparative study. Gauss quadrature formula. Study of least square principle and its application in curve fitting. Solution of algebraic and transcendental equation by graphical method and Newton-Raphson method. Newton-Raphson method for the solution of simultaneous equations. Numerical solution of simple first order differential equation by Eulers method, Picards method and Runge-Kutta method.

**MCE 4303      Engineering Mechanics II      3- 0      Credit 3.00**

Newton's Second Law of Motion, Equations of motions, momentum, inertia force, D'Alembert's principle.

Velocity and Acceleration: Relative velocity, instantaneous centre, velocities in mechanisms, relative velocity and acceleration diagram, Coriolis Component.

Angular Motion: Equations of angular motion, relationship between torque, angular acceleration and moment of inertia.

Rigid Body Motion

Simple Harmonic Motion: Characteristics, relationship between restoring force, displacement, velocity, acceleration, period and frequency.

Work and Energy: Work, power and energy, Power and Efficiency, Conservation Theorems, Momentum and Impulse, Conservation of Momentum, Impact, Turning moment, Effort and resistance,

Simple stresses and strains: tensile, compressive and shear stresses, Hooke's law, Modulus of elasticity and Shear Modulus, stress- strain diagrams, Poisson's ratio, Thermal and centrifugal stress, Factor of Safety, stresses in axial members, thin walled cylinders and spheres.

**MCE 4304      Engineering Mechanics II Lab      0-3/2 Credit 0.75**

Experiments based on MCE 4303.

**MCE 4305      Thermodynamics I      3- 0 Credit 3.00**

Introduction to thermodynamics, thermodynamic systems, properties, states, processes, and cycles. Temperature, temperature scales. Zeroth law of thermodynamics. Energy, kinetic energy, potential energy, internal energy, solar and other renewable energy, work and heat. Work for closed system processes.

First law of thermodynamics and its applications to closed systems. Specific heats, universal gas constant. Applications of the first law to steady-state steady-flow open systems, flow work, enthalpy.

Second law of thermodynamics, reversible and irreversible processes, entropy, cycle efficiency.

Ideal cycles: Carnot cycle, Stirling cycle, Ericsson cycle, Brayton cycle, Otto cycle, diesel cycle, dual cycle.

Ideal gas mixtures, relationships for mixtures of gases, properties of mixtures of gases.

Fuels and combustion, solid, liquid and gaseous fuels, requirements of a good fuel, calorific values and their determination, theoretical and excess air requirements for combustion, flue gas analysis.

Internal combustion engines, four-stroke and two-stroke cycle petrol engines, diesel engines, valve timing diagram and indicator diagram, methods of ignition, lubrication system, cooling system.

**MCE 4306      Thermodynamics-I Lab    0 - 3/2                  Credit 0.75**  
Experiments based on MCE 4305.

**MCE 4311      Fluid Mechanics - I                  3- 0                  Credit 3.00**

Fluid properties and definitions. Fluid Statics, Pressure variation, manometry, forces on submerged plane and curved surfaces, buoyancy, floatation and stability.

Fluid flow concepts, types of flow, continuity of equation.

Flow of incompressible ideal fluids, Euler's equation, Bernoulli's equation, applications of Bernoulli's equation. Flow of incompressible viscous fluids through pipes, laminar and turbulent flow, Darcy-Weisbach equation, Hagen- Poiseuille equation, Moody's diagram. Minor losses. Transmission of power through pipes and nozzles, water hammer, pipes in series and parallel, branched pipes.

Introduction to open channel flow, applications of Chezy-Manning equation.

Measurements of velocity and flow rates- pitot static tube, anemometer and currentmeter, venturimeter, orificemeter, nozzle meter, V-notch and rectangular weir.

**MCE 4312      Fluid Mechanics – I Lab      0- 3/2      Credit 0.75**

Experiments based on MCE 4311.

**MCE 4321      Manufacturing Processes      3- 0      Credit 3.00**

Introduction; Classification of manufacturing processes; Different machining processes; Cutting tools; Theory of metal cutting; Cutting conditions and cutting force; Study of metal forming; Welding and other joining processes; Fundamentals of casting processes; Powder metallurgy; Fabrications of plastics; Manufacture of gears, threads, modern machining processes. Introduction to the manufacturing system and automation. Accuracy of Machining, Measurement of dimensions and forms. Screw thread and gear measurement, Measurement of surface finishing.

**MCE 4322      Manufacturing Process Practices      0- 3/2      Credit 0.75**

Workshop practice based on MCE 4321.

**MChE 4341 Material and Energy Balance      3-0      Credit 3.00**

Review of material balance involving recycle and purging operations. Operations involving vaporization, humidification, psychrometry and phase diagrams. Energy balance involving change of phases. Enthalpy-composition diagrams. Heats of formation and reaction: effects of temperature and pressure. Material balances with chemical reactions and multiple components including use of algebraic techniques. Energy balances on chemical processes. Stoichiometry and unit operations in industrial processes. Unsteady state process calculation

**MChE 4342 Material and Energy Balance Lab      0-3      Credit 1.50**

Problem solving class based on MChE-4341.

**Math 4403 Mathematics IV      3 - 0      Credit 3.00**

**Complex variable:** Complex function, Analytic function. Cauchy-Riemann equations. Cauchy's Integral theorem. Cauchy's integral formula. Residues, Residue theorem. Conformal mapping, contour integration.

**Laplace transform:** Laplace transformation and application. Use of Laplace transformation in solution of ordinary and partial differential equations.

Series solution, Bessel function, Legendre function, elliptic integral, Beta, Gamma Functions, Tensor Fourier series, even and odd functions. Fourier integral, Fourier transform and their uses in solving boundary value problems.

**Math 4404      Mathematics Practice - IV      0- 3/2      Credit 0.75**

Sessional in the Computer Centre based on Math 4303.

**Chem 4407      Organic Chemistry      3-0                      Credit 3.00**

The hybridization of carbon atom and covalent bonding. A comprehensive study of aliphatic hydrocarbons with special reference to nomenclatures, preparation, properties and important uses. Types of reactions of aliphatic hydrocarbons and their industrial applications. Structure, nomenclature, preparation, properties, reactions and industrial applications of aliphatic hydrocarbon homologues. Aromatic compounds and aromaticity; preparation, properties, reactions and industrial applications of benzene and its derivatives. Heterocyclic compounds and their applications.

**Chem 4408 Organic Chemistry Sessional      0-3/2      Credit 1.50**

Detection of elements in organic compounds. Identification of functional groups. Preparation of different organic compounds. Separation, purification and characterization of organic compounds.

**MCE 4405      Thermodynamics II                      3 - 0                      Credit 3.00**

Liquids and vapours. Properties of steam, dryness fraction, enthalpy, entropy, specific volume. Use of steam tables and Mollier diagram.

Steam generators, classification, types of boilers, boiler mountings and accessories, superheater, economizer, air-preheater. Vapour power cycles, Carnot cycle, Rankine cycle, reheat and regenerative cycles. Steam nozzles, steam turbines and their classifications, velocity diagrams. Condenser and feed pump. Water impurities and water treatment.

Principles of refrigeration, vapour compression and vapour-absorption systems. Properties of refrigerants. Bell-Coleman cycle. Mixtures of gases and vapours, psychrometry and different terms, psychrometric chart, psychrometric processes, Human comfort. Introduction to basic air conditioning systems.

**MCE 4406      Thermodynamics II Lab      0- 3/2      Credit 0.75**  
Experiments based on MCE 4405.

**MCE 4407      Instrumentation and      2- 0      Credit 2.00**  
**Measurements**

Introduction : Industrial instrumentation, Accuracy, Reliability, Sensitivity, Error Analysis. Temperature Measurement, Mechanical, mercury in glass thermometers, bi-metal thermometers, pressure spring thermometers, response to change in temperature; Thermocouple, the laws of intermediate temperatures and metals. Bridge Network. Resistance thermometer, radiation measuring thermometers. Pressure measurement, Manometers, Elastic Deformation elements, bellows, pressure transducers: resistance capacitance induction type, differential pressure measurement. Flow measurement: flow nozzle, measurement conversion methods; turbine meter, electromagnetic meter, Mass flow measurement. Level measurement, Capacitance probe type element, electrical, probe type element, float-type element, transmitting pneumatic and electrical, displacement type of element. Differential pressure type elements, gama-ray-type elements, detection and measurement of solids. Exhaust Gas Analyser.

Tachometry: D.C and A.C. tachometry, Contactless, techniques, Specific gravity measurement: tubular-float displacement type, float-type, differential pressure type, gamma ray type, Calibration fundamentals of all types of instruments. Introduction to NDT methods.

**MCE 4408      Instrumentation and      0- 2      Credit 1.00**  
**Measurements Lab**

Experiments based on MCE 4407.

**MCE 4411      Fluid Mechanics II      3- 0      Credit 3.00**

Flow of compressible ideal fluid, relations for gases, energy equation, Mach number, stagnation point, Convergent nozzle, convergent divergent nozzle. Compressible fluid flow through pipes - adiabatic flow with friction, diabetic flow without friction, and isothermal flow with

friction. Normal and oblique shock. Lubrication of bearings, thin film lubrication, properties of petroleum lubricating oils.

Flow of incompressible fluids around immersed bodies, boundary layer concept, lift and drag, Dimensional analysis.

Impact of water jets, forces of jets impinging on fixed and hinged plates, moving plates, and fixed and moving curved vanes. Pressure of water due to deviated flow. Principles of water jet propulsion, propulsion of ships by water jets.

**MCE 4412      Fluid Mechanics II Lab      0- 3/2      Credit 0.75**  
Experiments based on MCE 4411.

**MCE 4413      Heat Transfer      3- 0      Credit 3.00**

Basic modes and laws of heat transfer.

Conduction: Steady-state one dimensional heat transfer through single and composite walls, critical thickness of insulation. Steady-state multidimensional conduction and numerical methods. Transient heat transfer - lumped heat capacity system, use of charts. Simple periodic processes.

Radiation: Physical mechanism, blackbody, gray body, radiation properties. Angle factor, radiation exchange, radiation shields, radiation heat transfer coefficient.

Convection: Forced and natural convection. Heat transfer correlations for forced convection in passages and over surfaces. Heat transfer correlations for natural convection over surfaces and in enclosed spaces. Condensation and boiling heat transfer.

Heat Exchangers: Types of heat exchangers, temperature distribution, log-mean temperature difference, effectiveness-NTU method, fouling factors, compact heat exchangers.

**MCE 4414      Heat Transfer Lab      0- 3/2      Credit 0.75**  
Experiments based on MCE 4413.

**MCE 4500 Project and Report      0-6      Credit-3.00**

The students are required to undertake a project to provide an opportunity to develop judgement, initiative and self reliance. Depending on the nature of the project it may be undertaken by an



individual or group. The result must be submitted in the form of a report along with the products, if any.

**MCE 4503      Mechanics of Materials      4- 0      Credit 4.00**

Introduction, Axially Loaded Member, Indeterminate Members.

Torsion: Relationship between torque, shear stress and angle of twist, power-torque relation, stresses and deflections in helical springs, Thin Shells.

Shear force and Bending Moment: shear force and bending moment diagrams and equations. Locating Maximum Bending Moment, Point of Inflection, torsion and leaf spring.

Stresses in beams: Flexure Formula, Shear Stress Distribution, finding deflections from bending moment diagrams and by double integration, continuous beams, Beams of Two Materials.

Columns and Struts: critical load conditions, influence of end conditions. Euler's theory, other empirical formulae.

Combined Stresses: combined loading, principal planes, principal stresses, maximum shear stress, Mohr's circle for determining principal stresses. Strain Energy. Combination of different loads.

Theories of failures: Fatigue strength, Endurance limits, design stress, stress concentration, service factor. Impact loads.

Thick walled cylinders: Compound cylinders, stresses in thick walled cylinders. Experimental Stress Analysis: Welded and Riveted Joint

**MCE 4504      Mechanics of Materials Lab      0- 3/2      Credit 0.75**

Experiments based on MCE 4503.

**MCE 4505      Fluid Machinery      3- 0      Credit 3.00**

Hydraulic turbines, Euler turbine equation, degree of reaction, impulse and reaction turbines, Pelton wheel, Francis turbine, Kaplan turbine, main components, and their performance. Specific speed. Hydraulic power plants, selection of turbines and sites.

Hydraulic intensifiers, jacks, cranes and lifts.

Introduction to fluid movers. Classification of pumps. Reciprocating pumps, applications, operating principles, performance characteristics. Centrifugal pumps, applications, operating principles, performance characteristics, cavitation, priming, parallel and series operations, specific speed, selection. Turbine pump, construction, working principles, characteristics, applications. Applications and selection of gear pumps, vane pumps and piston pumps.

Reciprocating compressors, principles of operation, single-stage and multi-stage compressors, intercooling, applications. Centrifugal compressors and axial flow compressors, performance characteristics, efficiencies, applications, selection. Applications and selection of rotary, screw and lobe type compressors. Fans and blowers, operating principles, types, applications and performances.

**MCE 4506      Fluid Machinery Lab      0- 3/2      Credit 0.75**

Experiments based on MCE 4505.

**MCE 4507      Control and Automation      2- 0      Credit 2.00**

Introduction, Automation, Classification of Control Systems, Control systems terminology; Block diagrams, servomechanisms and regulators. Linear systems and differential equations; operator D and characteristic equation, the free, forced and total response.

Transient Response Analysis; Impulse response, First and Second order system, stability criterion. Basic Control Action and Industrial Automatic Controls; Proportional, Derivative and Integral Controllers, fluids. Automated Mechanism; Transfer and orientation mechanism, Escapements. Hydraulic and Pneumatic Control systems; Actuators and applications; Directional, Flow control and Pressure control valves. Relieve valve, Pneumatic servo system, Hydraulic circuits; Speed control system for rollers and for turbine, tachometers, Logic Circuit: Relay contact logic circuits, gates, integrated circuits, ON-OFF Level control system. Symbols for fluid system components: Two position valve, three position four port valves, push, lever, pedal button, solenoid, pilot pressure, non-return valve, restrictions, shuttle valve, pilot pressure...etc. Logic modes, logic gates, logic systems, logic system installation, Industrial pneumatic circuits; pulse, delay circuits, circuits for chucking, and feeding, circuits for clamping and feeding, circuits for sequence operation, industrial Hydraulic circuits, press circuits, manual start, Automatic return, Two speed, fast approach,

regenerative circuits, deceleration, intensifier, safety circuits, common causes of failure, fault finding.

**MCE 4508 Control and Automation Lab 0- 2 Credit 1.00**

Lab experiment based on MCE 4507.

**Chem 4509 Instrumental Methods 3-0 Credit 3.00**

Study of the following methods and equipments: Calorimetry and photometry, pH and conductivity measurements, refractometry, flame photometer, infrared spectroscopy, atomic absorption spectrometry, emission spectroscopy, Orsat analysis, gas chromatography, thermal analysis, x-ray methods. IR. UV, Mass and NMR spectroscopy.

**MCE 4521 Materials Engineering 3- 0 Credit 3.00**

Nature and properties of materials. Production of pig iron, furnaces for converting pig iron. Production of different grade of cast iron. Classification of steel, steel manufacturing processes, production of alloy steels, equilibrium diagrams. Production of non ferrous metals, smelting, production of Aluminum, Magnesium, Copper and lead. Aluminum Alloys, Copper Alloys. Magnesium Alloys, die casting alloys. Non metallic Materials: Plastics, Elastomers, Ceramics, and Composite. Powder metallurgy. General principles of heat treatment, surface heat treatment for ferrous and nonferrous materials: Material Selection, Micrography.

**MCE 4522 Materials Engineering Lab 0- 3/2 Credit 0.75**

Experiments based on MCE 4521.

**MCE 4523 Metal Forming and Fabrication 3- 0 Credit 3.00**

Theory of metal forming. Mechanics, principle of operations, equipments and applications of different hot working, cold working and sheet metal working processes. Detail study of metal joining processes: Gas welding, arc welding and resistance welding. Quality control, inspection and costing of welded joints.

**MCE 4524 Metal Forming and Fabrication Lab 0- 3/2 Credit 0.75**

Lab Experiments based on MCE 4523.

**MCE 4531 Statistics and Quality Control 3-0 Credit 3.00**

Basic laws of probability; Conditional probability; Random variables; Measures of central tendency and dispersion; Probability distributions; Sampling; Central limit theorem; Estimation and confidence interval; Statistical hypothesis and testing; Correlation and Regression analysis; analysis of variance.

Concept of quality; Identification of quality characteristics: Quality of design, conformance and performance; Deming's on quality and productivity; Quality costs and their interpretation.

Control and measurement of quality: Elementary SPC tools; Process capability analysis; Design of experiments. Acceptance Sampling plans. Quality standards: ISO 9000 vs ISO 14000. Total Quality management (TQM); Application of TQM philosophy.

**MCE 4532 Statistics and Quality Control Lab 0-2 Credit 1.00**

Experiments based on MCE 4531.

**MCE 4533 Engineering System Design 3-0 Credit 3.00**

Scope and development of systematic Design, Fundamentals of Engineering systems and the systemic approach, Design process, Product planning and clarification of the task, conceptual design, Embodiment design.

**MCE 4534 Engineering System Design Lab 0- 3/2 Credit 0.75**

Laboratory experiments based on MCE 4533.

**MCE 4537 Computer Aided Design 3-0 Credit 3.00**

Design process and the role of CAD, defining the model, Techniques for geometric modeling. Three dimensional modeling, Use of finite Elements as a CAD Tool.

Elements of interactive computer graphics, entity manipulation and data storage, application of the CAD model in design. Standards for computer aided design, intelligence of CAD.

**MCE 4538      Computer Aided Design      0- 3/2      Credit 0.75  
Lab**

Experiments based on MCE 4537.

**MCE 4543      Graphic Programming      3- 0      Credit 3.00  
and Design**

Traditional Drafting and CAD, Processing Equipment, Software, Interactive systems; Principle of graphics programming, computerising the design processes, graphic system and software, pictorial representation, computerised descriptive geometry, computerised vector geometry, computerised solid geometry; CADD chart and graphs; sample programmes and user problems.

**MCE4544      Graphic Programming and      0-3/2      Credit 0.75  
Design Lab**

Experiments based on MCE 4543.

**MCE 4547      Computer Aided Design      3 - 0      Credit 3.00  
and Manufacturing**

Uses of Computer Aided Design; CAD Hardware, CAD software, Computer aided draughting, three dimensional modeling, use of Finite Elements as a CAD Tool; computer numerical controlled metal working, computer aided quality control, manufacturing aids and systems, computer aided management and production control; computer numerical control and programming CNC machines, linking CAD with CAM, uses of robotics in CAM.

**MCE 4548      Computer Aided Design      0 - 3/2      Credit 0.75  
and Manufacturing Lab**

Experiments based on MCE 4547

**MCE 4551      Refrigeration – I      3 - 0      Credit 3.00**

Brief history and applications of refrigeration. Review of thermodynamics related to refrigeration. Reversed Carnot cycle, use of vapour in reversed Carnot cycle. Refrigerator and heat pump. Methods

to produce refrigeration. Ideal and actual vapour compression refrigeration cycles. Major components of vapour compression refrigeration systems. Cooling towers. Refrigerants and their designations, desirable properties, primary and secondary refrigerants. Absorption refrigeration systems. Comparison with vapour compression system. Basic air cycle refrigeration system, types used in aircrafts. Refrigerant flow controls, methods of flow controls. Thermoelectric refrigeration. Introduction to low-temperature refrigeration. Applications. Cascade system.

**MCE 4552 Refrigeration Lab I 0 - 3/2 Credit 0.75**

Experiments and study based on MCE 4551.

**MCE 4555 Control System Technology 3- 0 Credit 3.00**

Process Control loops, lags, measuring systems, basic control schemes, control actions, automatic controller classification, automatic controller types, correcting units, automatic controller tuning, advanced control schemes, programme controllers, ancillary equipment Logic system: Logic modes, logic gates, logic systems, logic system installations, testing logic systems, computers. Fault diagnosis: Introduction, terminology, systematic fault location, fault diagnosis: rectification of the fault, checking the system.

**MCE 4556 Control System Technology Lab 0- 3/2 Credit 0.75**

Experiments and study based on MCE 4555.

**MCE 4561 Instrumental Methods of Analysis 3- 0 Credit 3.00**

Study of the following methods and equipment: Calorimetry and photometry, pH and conductivity measurements, refractometry, flame photometer, infrared spectroscopy, atomic absorption spectrometry, emission spectroscopy, Orsat Analysis, Gas chromatography, Thermal analysis, X-ray methods.

**MCE 4562 Instrumental Methods of Analysis Lab 0-3/2 Credit 0.75**

Experiments based on MCE 4561.

**MCE 4573 Renewable Energy Resources 3-0 Credit 3.00**

Renewable energy, definition, different types; fundamentals of solar radiation, available solar radiation, estimation and measurements, analysis of solar radiation data, solar radiation transmission through covers and absorption by opaque surfaces; wind, geothermal, wave and tidal energy, biogas, biomass and other renewable energy sources.

**MCE 4574 Renewable Energy Resources Lab 0-3/2 Credit 0.75**

Experiments based on MCE 4573.

**MCE 4585 Automotive Technology- I 3-0 Credit 3.00**

Introduction to motor vehicles. Motor vehicle science, tractive effort and resistances, over turning, skidding, load transfer during breaking, engine performances, efficiencies, SFC, dynamometers, Engine fundamentals, spark ignition engines, Compression ignition engines, cylinder arrangements, functions, design aspect and construction detail of engine parts. Fuel system, physical and chemical properties of motor fuels, pump, carburetors, injectors, exhaust silencer. Lubrication system. Cooling system, Charging system, starter System, Ignition system.

**MCE4586 Automotive Technology Practice I 0-3/2 Credit 0.75**

Experiments and study based on MCE 4585.

**MCE 4587 Automotive Maintenance Engineering I 3-0 Credit 3.00**

Automotive testing methods, shop facilities, test equipments and tooling, use of ignition timing lights, compression tester, vacuum gage, electrical test meter, general principles of servicing, maintenance and repair of automotive engine and vehicles, diagnosis of engine and

vehicle troubles and remedy, tuning-up, battery checking and charging; general servicing and servicing, check up of ignition system, cooling system, lubrication system, electrical system, including their equipments. Engine overhauling, break down maintenance and repair, Accepted noise level and exhaust pollution control.

**MCE 4588      Automotive Maintenance      0-3/2      Credit 0.75**  
**Engineering Practice-I**

Experiments, practice and study based on MCE 4587.

**MChE 4501      Separation Process I                      3-0      Credit 3.00**

Introduction to mass transfer processes. Phase equilibria. Equilibrium stage concept. Solvent Extraction: liquid-liquid extraction in single and multiple contact extractor with completely immiscible and partially miscible solvent; use of triangular diagram to represent equilibria; batch and continuous leaching. Binary distillation: equilibrium flash and differential distillation: batch and continuous distillation with reflux; simplified methods for stage calculations. Gas-liquid absorption: analytical and graphical methods for stage calculations. Tray hydraulics tray efficiency.

**MChE 4502      Separation Processes lab I      0-3/2      Credit 0.75**

Experiments based on MChE 4501.

**MChE 4503      Polymer Chemistry and                      3-0      Credit 3.00**  
**Petrochemical Technology**

Introduction: Structure, morphology and properties of polymer, viscoelasticity and its measurements, polymeric fluids, molecular weight and size measurement, kinetics for polymerization. Petrochemicals; manufacturing processes of acetylene, ethylene, propylene, butadiene, isoprene, methanol, vinyl chloride, vinylacetate, acetic acid, styrene, etc. Plastics; Manufacturing process, properties and uses of polyethylene, polypropylene, PVC, polystyrene, polyamides, polyesters polyurethanes, etc. Thermosetting plastics; manufacturing processes, properties and uses of formaldehyde resins, phenol, urea and melamine.



**MChE 4504 Polymer Chemistry and Petrochemical Technology Lab 0-3/2 Credit 0.75**

Experiments based on MChE 4503.

**MChE 4506 Chemical Equipment Maintenance Lab 3-0 Credit 1.50**

Experiments on techniques of maintaining different equipments such as gas chromatograph, GLC. Spectro photometer, cyclic voltameter, Polarometer, and other apparatus used in Chemical Engineering and Chemistry lab.

**MChE 4507 Unit Operations 3-0 Credit 3.00**

Size reduction and mixing of solids; Crushing, grinding, mixing, etc. Mechanical separators: Screening, sedimentation, filtrations, cyclones, centrifuge, etc. Crystallization, drying and evaporation. Pump and Compressor in industrial use.

**MChE 4508 Unit Operations Lab 0-3/2 Credit 0.75**

Experiments based on MChE 4507.

**MChE 4509 Fertilizer, Pulp and Paper Technology 3-0 Credit-3.00**

Introduction to Fertilizer industries, manufacturing processes of nitrogen fertilizer, design considerations, status of production, waste disposal methods, production and distribution economics and uses. Phosphate fertilizer-production, marketing and uses: comparative economics of different fertilizers from phosphoric acid. Complex fertilizers: nitrophosphate. Manufacturing process of different potash fertilizers and other uses. Compound fertilizers and their economics. Introduction to pulp and paper industries. Preparation of raw material. Mechanical and semi-chemical pulping. Different processes of chemical pulping. Chemistry of Kraft process. Digestion of pulp. Chemical recovery and energy balances. Bleaching, Beating, sizing and quality control. Paper making. Technical auditing.

**MChE 4510 Fertilizer, Pulp and Paper Technology Lab 0-3/2 Credit-0.75**

Experiments based on course MChE-4509.

**MCE 4603 Mechanics of Machines 3-0 Credit 3.00**

Kinematics: Velocity acceleration of any point on of a link, four-bar chain and slider-crank mechanism, calculation of torque and forces from velocity and acceleration diagrams.

Gear trains and Drives: Gear Profiles Analysis of Geared systems for torque, velocity and acceleration, speed ratio of epicyclic trains. Fly wheels: Function of a flywheel, inertia forces, turning moment diagrams, maximum fluctuation of energy, co-efficient of fluctuation of speed, moment of inertia of a flywheel.

Governors: Function, analysis of different type of governors, power, effort and stability.

Balancing: Static and dynamic balancing of system, masses in the same plane, masses in different planes, balancing reciprocating masses. Balancing Machines.

Vibration: Spring-mass elastic system, expression for motion, natural frequency, torsional and transverse vibration, critical speed, natural frequency of two rotor system, steady-state vibration.

**MCE 4604 Mechanics of Machines Lab 0-3/2 Credit 0.75**

Lab Experiments based on MCE 4603.

**MChE 4607 Pollution and its control 3-0 Credit 3.00**

Pollution, Pollutants and their classification. Air pollutants from industrial and other sources. Air pollution from automobiles. Analytical and instrumental techniques used in the estimation of atmospheric pollutants. Air pollution control.

Classification of water pollutants: waste water from some typical industries: effect and treatment of waste water from Textile, Leather and Fertilizer industries, Dairy, Rubber, Soap and detergent industries cane sugar, edible oil and oil refinery. Solid waste Pollution: treatment and disposal. Hazardous wastes: Environmental problems and management of nuclear wastes, biomedical wastes, Chemical toxic wastes Chemical Hazards etc. Social and economic aspects of Pollution.

**MChE 4608 Pollution and its control Lab 0-3/2 Credit 0.75**

Experiments based on course MChE-4607.

**MCE 4621 Tool Engineering 3-0 Credit 3.00**

Design morphology, morphology, principles of workpiece location, locator design; clamps: clamping force and clamp design; Jigs/Fixtures: types, working principle, design of jigs/ fixtures; Dies: types, die parts, design of dies for blanking, shearing, bending, drawing, piercing and other operations; Design and manufacturing process of cutting tools, drills, milling cutters, broaching tools, etc.

**MCE 4622 Tool Engineering Lab 0- 3/2 Credit 0.75**

Experiments based on MCE 4621.

**MChE 4623 Plant Design and Economics 2-0 Credit 2.00**

National economic policies. Five Year plans and sectoral plans. Concepts of value added and technology content added. Elements of input-output analysis. Alternatives in resource inputs. Investment costs. Interest calculations. Depreciation, Profitability and alternative investments. Project analysis: DCF, IRR, ERR etc. elements of risk analysis. Break even analysis and Minimum cost analysis. Capital budgeting. Functions of management in CPI: decision making; organizing, planning, directing, communicating, and controlling. Information management. Principles of production management. Marketing. Quantitative techniques in decision making: Network analysis, Linear programming.

**MCE 4625 Theory of Metal Working 3- 0 Credit 3.00**

Mechanics of metal cutting, temperatures in metal cutting, tool life and tool wear, cutting fluid and surface roughness, chip control, optimum conditions for cutting, Factors involving in selection of cutting condition and selection of cutting condition single point and multipoint cutting tools. economics of metal cutting operations. Process planning, Computer aided design for machining and process planing. Design for machining, Non-conventional machining processes. Principles of metal forming, Metal flow and nature of stresses in metal forming operations. Factors involving in designing a forming process.

**MCE 4626 Theory of Metal Working Practice 0- 3/2 Credit 0.75**

Experiments based on MCE 4625.

**MCE 4627 Machine Tools 2- 0 Credit 2.00**

Characteristics of machine tools, recent developments in the design of machine tools; Drive system of machine tools, design of mechanical drive; speed gear boxes; feed gear boxes, infinitely variable drives, PIV and other stepless drives, hydraulic drives, electrical drives; Bearings, spindles, slide ways of machine tools, machine tool structure.

Detailed case study of engine, turret and automatic lathes, drilling machines, shaper machines, planer machines, milling machines, grinding machines, gear shaping and gear hobbing machines, forging machines, NC and CNC machine tools, Dynamics of machine tools, installation and acceptance tests of machine tools, automatic transfer lines.

**MCE 4628 Machine Tools Practice 0- 3/2 Credit 0.75**

Experiments and study based on MCE 4627.

**MCE 4629 Engineering Management 3-0 Credit 3.00**

Basic management theory and practice, division of management structure into elemental functions, management functions and their inter-relationships, industrial organisation and organisational objectives, communications and job instructions, management of human resources, team work, leadership and human relationship, personnel system, performance appraisal and incentive scheme, manpower planning-forecasting labour demand, planning, scheduling and organising work, industrial relations-general framework, procedures for settlement of disputes, current development; industrial accident prevention, plant layout, working environment and material handling, work study, inventory control, basic costing and budgetary control.

**MCE 4639 Machine Design - I 3- 0 Credit 3.00**

Properties of related engineering materials, selection of materials, working stresses, factor of safety, combined stresses, fatigue stresses, stress concentration service factor.

Design of shafts, keys and splines, coupling, threaded fasteners, helical springs, spur gears, journal bearings, ball and roller bearings flat belts and v-belts and rivetted joints.

**MCE 4640 Machine Design Practice – I                      0- 2            Credit 1.00**

Practices based on MCE 4639.

**MCE 4651 Plant Operation and    3- 0            Credit 3.00**  
**Maintenance**

Introduction to refrigeration and A/C system and equipments, Shop facilities: Compressed air and water, crane and work lifts, fire fighting equipments. General and special purpose tools, electrical and mechanical equipments and measuring instruments, their use, theory and calibration. Layout, foundation, installation, commissioning, testing and adjustments of different kinds of refrigerating and A/C plants (including its electrical and mechanical accessories), viz, cold storage, home and farm freezers, walk-in freezers, beverage and brewery units, ice plants, window unit, package unit, central A/C system plants. Servicing, preventive and break down maintenance of various kinds of refrigerating and A/C Plants as mentioned, repair and overhaul of components and the plant, store supply and control. Trouble shooting, leak detection, various types of motors and drives, its selection and maintenance. Shop and plant operation safety, storing of parts and equipment, post and pre-shipment inspection, renovation and balancing, customer service and economics.

**MCE 4652 Plant Operation and    0- 3/2            Credit 0.75**  
**Maintenance Practice**

Experiments, practice and study based on MCE 4651.

**MCE 4653 Air-conditioning    3- 0            Credit 3.00**

Definitions of air conditioning and ventilation, applications. Psychrometrics. Definitions for psychrometric properties and their relations. Psychrometric processes. Sensible and latent heats. Psychrometric calculations for air conditioning. Ventilation requirements, calculations of ventilation loads Outside and inside design conditions. Calculations of overall heat transfer coefficients for heat transmission through building structures. Heating and cooling load calculations. By-pass factor of cooling coils. Calculations of supply air quantities and cooling capacity. Selection of heating/cooling units. Introduction to air distribution system.

**MCE 4654      Air-conditioning Lab      0-3/2      Credit 0.75**

Experiments and study based on MCE 4653.

**MCE 4661      Hydraulic, Pneumatic and      3-0      Credit 3.00**  
**Electric Drive Systems**

Introduction to Drive Systems. Types of Drive Systems, Selection of drive systems. Pneumatic and Hydraulic Systems, Principles of Hydraulics, Actuators; Types of Cylinders and Motors, Valves, Reservoirs, Components of Pneumatic Systems.

Solid State Devices: Semiconductor, Diodes, Transistors, Field Effect Transistors, Thyristors, Trigger Devices, Integrated Circuit. Electric Drives: Components and operation of DC and AC Motors, Types of Motors, Fractional Horse Power Motor, Speed Control of DC Motor; Shunt Field Control, Armature Control, Solid State Control.

**MCE 4662      Hydraulic, Pneumatic and      0- 3/2      Credit 0.75**  
**Electric Drive Systems Lab**

Experiments based on MCE 4661.

**MCE 4663      Automatic Control      3- 0      Credit 3.00**  
**Engineering**

Introduction: System Representation, Partial D.E., Laplace Transformation Method. Operational Notation, Mechanical Components, Electrical Components. Series and Parallel Components. Thermal Systems. Fluid Systems, Block Diagrams. Transient Response, Damping Ratio, Natural Frequency, Logarithmic Decrement. Hydraulic and Pneumatic Amplifiers and Servomotors. Speed Control Systems, Generalized Feedback Control Systems. Routh's stability criterion, Root Locus Method, Construction of Loci Sensitivity. Steady State Analysis, Equilibrium. Proportional, Integral, Proportional plus Integral Derivative (PID) Control System. Micro processors and Digital Control Systems, Computer Controlled Systems, Process Controllers, Frequency Response, Polar Plot.

**MCE 4664      Automatic Control                      0-3/2      Credit 0.75**  
**Engineering Lab**

Experiments based on MCE 4663.

**MCE 4671      Fossil Fuel Engineering                      3-0      Credit 3.00**

Classification, analysis and essential properties of fuels: introduction to exploration and production techniques of fossil fuels; processing, storage, handling, metering and safety; combustion and efficient utilisation; burners, furnaces, refractors, insulation materials, stacks; safety in burner and furnace operations.

**MCE 4672      Fossil Fuel Engineering Lab      0-3/2      Credit 0.75**

Experiments based on MCE 4671.

**MCE 4685      Automotive Technology- II      3-0      Credit 3.00**

Electrical circuits in automotive vehicle, vehicle lighting and other electrical equipment. Power transmission, function, construction detail and arrangements of clutches, gear boxes, universal joints, differential mechanism, rear axle. Steering system, front wheel geometry, cornering force. Brake system and its layout, servo assisted and power brakes. Suspension systems. Automotive chassis construction detail and mounting arrangements. Body mechanisms Engine arrangements. Tyres and its characteristics. Heating and air-conditioning.

**MCE 4686      Automotive Technology                      0-3/2      Credit 0.75**  
**Practice II**

Experiments and study based on MCE 4685.

**MCE 4687      Automotive Maintenance                      3-0      Credit 3.00**  
**Engineering II**

Servicing check up and repair of transmission, suspension, steering and braking system. Wheel alignment. Repair and maintenance of body mechanisms, door latches, locks, window regulators, wipers, bonnet. Denting and spray painting. Vehicle behavior, special material handling, vehicle security, vehicle inspection and testing, accidents and insurance covers. Workshop organisation and management, layout of service station, garage planning. Fleet transport maintenance and repair, vehicle livery and cleaning. Estimating, costing and invoicing.

**MCE 4688 Automotive Maintenance 0-3/2 Credit 0.75**  
**Engineering Practice- II**

Experiments, Practice and study based on MCE 4687.

**MChE 4600 Project 0-6 Credit 3.00**

The students are required to undertake a project to provide an opportunity to develop judgement, initiative, self, reliance. Depending on the nature of the project it may be undertaken by an individual or a group. The result must be submitted in the form of a report along with the products, if any.

**MChE 4601 Separation Process II 3-0 Credit 3.00**

Solution thermodynamics. Relationships among thermodynamic properties; Gibbs- Duhem Equation; Equilibrium constant; Phase rule and Duhem's theory for reacting system.

Extraction: Liquid-liquid extraction, use of triangular diagram for stage calculation single and multiple contact with completely immiscible and partially miscible solvent, leaching and washing of solids. Humidification, theory of wet bulb temperature, use of humidity chart, principles of simultaneous heat and mass transfer.

**MChE 4602 Separation Process Lab II 0-3/2 Credit 0.75**

Experiments based on MChE 4601.

**MChE 4603 Reaction Engineering 3-0 Credit 3.00**

Kinetics of homogeneous reactions: variables affecting rate; elementary and non-elementary reactions. Temperature and pressure effects. Determination of the reaction rate expression; molecular interpretations of kinetic phenomena; multiple reactions; auto-catalytic reactions. Basic concepts in reactor design: type of reactors; Batch Reactors and continuous reactors, isothermal operation; treatment of multiple reactions; temperature and energy effects in chemical reactors; Kinetics of heterogeneous reactions; mechanism of catalysis; types of catalysts; catalyst poison.

**MChE 4604 Reaction Engineering Lab 0-3 Credit 1.50**  
**(Reactor Design Lab)**

Laboratory work on fuel testing and based on MChE 4603.



**MChE 4621 Corrosion and Protection of Metals 3-0 Credit 3.00**

Corrosion and its mechanisms: Types of corrosion cells, Types of corrosion damage, corrosion tendency and electrode potential. Polarization and corrosion rates, Passivity, Characteristics of passivation Theories of Passivation. Pourbaix diagram. Theory of cathodic protection. Anodic Protection and trans passivity. Stress corrosion cracking of iron & steel. Mechanism of stress corrosion cracking. Hydrogen cracking and its mechanism, Corrosion fatigue and mechanism of corrosion fatigue. Fretting corrosion and its mechanism. Thermodynamics and kinetics of protective and non protective scales. Wagner theory of oxidation. Stray current corrosion. Sources and means for stray current corrosion. Protective coatings for the prevention of corrosion.

**MChE 4622 Corrosion and Protection of Metal Lab 0-3/2 Credit 0.75**

Experiments based on course MChE-4621.

**MChE 4631 Basic Control System Technology 2-0 Credit 2.00**

Process Control loops, lags, measuring systems, basic control schemes, control actions, automatic controller classification, automatic controller types, correcting units, automatic controller tuning, advanced control schemes, programme controllers, ancillary equipments Logic system: Logic modes, logic gates, logic systems, logic system installations, testing of logic systems, computers. Fault diagnosis: Introduction, terminology, systematic fault location, rectification of the fault checking system.

**MChE 4632 Basic Control System Technology Lab 0-3/2 Credit 0.75**

Experiments and study based on MCE 4631.

**MCE 4700 Project and Thesis - I 0-6 Credit 3.00**

The students are required to undertake a major project in the field of mechanical engineering. The objective is to provide an opportunity to the students to develop initiative, creative ability, confidence and engineering judgement. The results of the work should be submitted in the form of a report which should include appropriate drawings, charts, tables, references etc. together with product(s), if any.

**MCE 4705      Thermodynamics-III      3-0      Credit 3.00**

First law of thermodynamics, stored energy, applications of first law to open systems, general formulation, limitations of first law.

Second law of thermodynamics, equivalence of Clausius and Kelvin-Planck statements, perpetual motion machines. Reversible and irreversible processes and cycles. Consequences of the second law of thermodynamics, Clausius's inequality, entropy, availability and irreversibility. Third law of thermodynamics.

Gas power cycles and their comparison. Fuels and combustion, adiabatic flame temperature, combustion mechanisms in internal combustion engines.

Pure substance, phases, thermodynamic surfaces and properties, Clapeyron's equation. Gas-vapour mixtures. Vapour power cycles, ideal and real regenerative cycles, binary vapour cycle.

**MCE 4711      Fluid Mechanics-III      3-0      Credit 3.00**

Laminar and turbulent flow through pipes, eddy viscosity, mixing length, Reynolds stress, universal velocity distribution, seventh-root law laminar sublayer, hydraulically smooth and rough pipes.

Fluid flow about immersed bodies, laminar and turbulent boundary layers, analysis by integral method, boundary layer separation, drag and lift.

Liquid flow in open channels, Chezy equation, Chezy-Manning equation, best hydraulic cross-section, specific energy, critical depth and critical slope, hydraulic jump.

Introduction to inviscid incompressible flow, velocity potential, stream function, source-sink flow, vortex flow, doublet flow, flow around circular cylinder with and without circulation. Conformal mapping.

**MCE 4717      Engineering Economy      2- 0      Credit 2.00**

Introduction to engineering economic decision, cash flow analysis and basic concepts of discounting, cost of capital, required ROR equivalence.

Business mathematics: Investment appraisal criteria for economic decisions, present worth, internal rate of return, social consideration in investment, benefit-cost ratio.

Decisions involving depreciation and inflation, taxes, sensitivity analysis.

**MCE 4721      Manufacturing System      3- 0      Credit 3.00  
                         and Automation**

Type of production, type of automation, transfer machines, handling of components in Batch production and mass production,. Computer numerically controlled bending, cutting, grinding and plastic moulding. Manufacturing aid and systems, Flexible manufacturing system. Advanced Manufacturing technology. Computer aided management and quality control. Programming and control of CNC machine and Robot.

**MCE 4725      Machine Maintenance      3- 0      Credit 3.00  
                         Engineering**

Maintenance and maintainability concepts; Catastrophic failure models and probability distribution functions; Failure data analysis; Maintenance management methodology: maintenance objective, maintenance strategy, work planning and scheduling, maintenance resource planning, maintenance control; Maintenance information systems; quantitative techniques in maintenance; Modern maintenance concepts like Total Productive Maintenance (TPM). Case Study.

**MCE 4735      Advanced Drafting      3-0      Credit 3.00**

Solution of special problems, further drafting practice in making working drawings of simple equipment from a set of design data. Necessity of technical illustration in engineering field, technical illustrations, exploded views, space diagrams, installation illustration, the use of shades and shadows; cut away illustration of an assembly of engineering parts, contemporary advanced practices in mechanical drafting, use of photographs, engineering chart, bar chart, flow chart, etc.

**MCE 4739      Machine Design II      3-0      Credit 3.00**

Endurance strength, design of members subjected to variable loads, critical speeds of shafts.  
Design of helical gears, bevel gears, worm gears, power screws, clutches, brakes, leaf springs, tapered roller bearings, welding, bolted members, chains, wire ropes.

**MCE 4740 Machine Design Practice II 0-2 Credit 1.00**

Practices based on MCE 4739.

**MCE 4745 Computer Aided Numerical 3-0 Credit 3.00  
Controlled Manufacturing**

Design/Manufacturing interface; limitation of traditional engineering approaches and current themes in manufacturing engineering; Group technology. Design for manufacturing and assembly in the light of computer aided manufacturing. Computer aided bending, cutting, grinding and assembling operation, computer aided plastic compression and injection molding. Quality approach and techniques of quality engineering; Fundamentals and data preparation for numerical control; machining of curved surfaces, rapid prototyping. Computer aided production activity control and scheduling technique.

**MCE 4751 Air Conditioning System 3-0 Credit 3.00  
Engineering**

Introduction, Moist air properties and conditioning process, comfort and health.

Combined heat and mass transfer processes. Heat transmission in building structure. Solar radiation, space heating and cooling load and their calculations. Air-conditioning calculations. Complete Air-conditioning systems. Fluid flow, pumps and fans, water piping and ducts design. Room air distribution. Preparation of schedules of components.

**MCE 4761 Control System 3-0 Credit 3.00  
Instrumentation**

Introduction, Control Systems, Process Control Systems, Servomechanisms, Synchro Systems, Measuring Systems. Display Units: Analogue, Digital, Optical lever, Chart recorders, X-Y, and XY/t recorder, cathode ray oscilloscope, Digital display, Indicator tubes, LED, Liquid Crystals. Lever Mechanisms and Adjustments, Square Root and Integration, Pilots and Relays. Centralized Control Computers, Automatic Management Information and Control Systems. Safety Regulations: Basic Rules for Operation, Basic Rules for Protection of Respiratory organs.

**MCE 4771      Energy Conservation and      3-0      Credit 3.00**  
**Management**

Review of commercial energy utilization and conversion systems; energy and heat balance, insulation techniques, water heat recovery; generation, transmission and distribution of electrical energy, reduction of losses; energy conservation in transportation, buildings and industry; energy and environment. Energy auditing, energy saving schemes, energy management activities, economic assessment.

This course includes laboratory experiments and workshop practices related to the courses of the seventh semester.

**MCE 4787      Automobile Engineering      3-0      Credit 3.00**

Review of Engine Fundamentals – cylinder arrangements. Design aspects and construction details of engine parts. Carburetors, fuel injection systems, EFI and emission. Lubrication, cooling, ignition, charging and starting systems. Engine performance, efficiency and specific fuel consumptions, Troubleshooting of engines.

Automotive chassis constructions details and mounting arrangements. Body mechanisms. Engine mounting. Heating and air conditioning. Electrical circuits. Fundamentals of Auto-electronics. Road transport rules and regulations.

**MCE 4780      Mechanical Engineering      0-3      Credit 1.50**  
**Lab-I**

Experiments and Workshop Practices related to the courses of Seventh Semester.

**MCE 4800      Project and Thesis II      0-6      Credit 3.00**

Continuation of the project.

**MCE 4803      Dynamics of Machines      3-0      Credit 3.00**

Introduction, Power Transmission by Belt, rope, chain. Brake, clutches, Dynamometers. Cams, Followers, Cam dynamics. Gyroscopic theory, analysis of stability of steady motions. Dynamics of reciprocating

engine. Balancing, Multicylinder inline and V engines, radial engines, direct and reverse crank.

Vibration: Single and two degrees of freedom. Damped Free and Forced Vibration, Whirling of shafts, Geared system. Lagrange's equation, energy methods, Rayleigh's method, vibration measuring instruments.

**MCE 4805      Power Plant Engineering      3-0      Credit 3.00**

Power plants, hydraulic and thermal power plants, types of thermal power plants. Demand and supply of electrical power.

Steam power plants: Fuels, coal, oil, natural gas, fuel-bed firing, suspension firing. Boilers, superheaters, reheaters, economisers, air-preheaters. Draft system. Steam prime movers and their controls, condensers, cooling towers, feed water heaters, reheat and regenerative power cycles, feed-water treatment.

Gas turbine power plants: Gas turbines, basic components, practical cycle, intercooler, reheater and heat exchangers, characteristics. Combined gas turbine and steam plant.

Diesel engine power plants. Diesel engines, their auxiliaries, fuel system, performance characteristics.

Introduction to nuclear power plants. Power plant economics, load curves, load curve analysis, selection of units, plant performance and operating characteristics, factors effecting cost of electrical energy, energy rates.

**MCE 4813      Heat and Mass Transfer      3 - 0      Credit 3.00**

Heat Transfer: Basic modes of heat transfer.

General heat conduction equation: Steady-state one-dimensional conduction, variable thermal conductivity, uniform heat generation, fins of uniform cross-section, steady-state two dimensional heat conduction, unsteady-state one-dimensional heat conduction.

Radiation: blackbody laws, radiation intensity, Kirchhoff's law, radiosity, angle factor, radiation exchange by network method. Solar radiation, solar radiation scattering and absorption by earth's atmosphere, greenhouse effect.

Forced convection: forced convection inside ducts, analogy between heat and momentum transfer, forced convection over a flat plate, boundary layer, analysis by integral method. Heat transfer with change of phase, laminar film condensation on flat plates and horizontal cylinders, analysis by Nusselt method, condensation number, correlation of boiling heat transfer.

Mass Transfer: Introduction, mass transfer by molecular diffusion, Fick's law of diffusion, mass transfer coefficient, simultaneous heat and mass transfer, mass transfer equipment.

**MCE 4821      Design for Manufacturing      3 - 0      Credit 3.00**

Product design: scope and application, approach in designing a product, identification of requirement, product specification, evaluation of design alternative. Product cost; cost element; cost analysis, Manufacturing methods, manufacturing difficulties, modification of design for ease of manufacture. Value engineering and its application in product design. Case studies of selected design of products.

**MCE 4823      Operations Research      3 - 0      Credit 3.00**

Introduction and scope of operation research; classical optimization techniques; Linear models; Simplex algorithm, duality; Transportation and Assignment algorithm, Game theory, Dynamic programming, queuing theory, Introduction to simulation.

**MCE 4827      Production Planning and Control      3 - 0      Credit 3.00**

Integrated purchase-production-marketing system, production systems, product /service life cycle, forecasting models, bill of materials. Material and inventory management: ABC analysis, coding and standardization, inventory models. Aggregate planning, Master production schedule (MPS), Material requirements planning (MRP), Manufacturing resource planning (MRPII), Enterprise resource planning (ERP), Capacity planning and Operation scheduling. Machine loading and line balancing. Plant layout.

Work study: Method study, time study, predetermined motion time systems (PMTS) and work sampling.

New frontiers: Supply chain management, optimized production technology, group technology, Total quality control (TQC), Just-in-time (JIT).

Maintenance management.

**MCE 4829      Industrial Management      3-0      Credit 3.00**

Management process, functions, roles and skills. Evolution of management thoughts. Management and Society: External environment, social responsibility and managerial ethics. Strategic management: Importance of strategic planning, strategic management process, Corporate and business level strategies. Organization and management: Organization design concepts, organization structures, job design. Human resources management: Human resource planning, selection, performance appraisal, employee motivation, reward systems, leadership, communication and interpersonal skills. Management information systems and decision support systems. Productivity management: Models for productivity measurement and analysis, productivity improvement techniques. Marketing management: Marketing concept, organization, strategies. Technology management: Technology assessment and selection, management of innovation and change.

**MCE 4835      Linkage and Motion      3-0      Credit 3.00**

Linear and angular motions, velocity and accelerations, velocity and acceleration analysis, velocity; velocity and acceleration diagrams of linkage Mechanisms, coupler curves, designing linkage mechanisms, study of selected mechanisms.

**MCE 4839      Mechatronics      3-0      Credit 3.00**

Introduction, System Concept, Benefits, Technology. CAD, CAM, Computer Integrated Systems, FMS, Manipulator, Actuator, Sensors and Vision Systems, Smart Robots, Artificial Intelligence. Applications: Factory Automation, Office Automation, Home Automation.

**MCE 4845      Robotics and Computer      3-0      Credit 3.00**  
**Integrated Manufacturing System**

Introduction, Terminology, Basic components, Robot Technology Levels. Manipulator Features, Arm Geometry, Rotation, Drive System, Work Envelopes, Mounting. Internal Components of Controllers, General Features, Input Power. Master Control, Memory.



Board, Servo Control. Robot Programming: Control Program, User's program, components of user's program, Related BASIC, VAL, Statements, Developing Programs, Flowcharting, Skip Function, Main program, Subprogram, Teach Pendant, Operator's panel, MDI, (Manual Data Input). Flexible Manufacturing System, Advantages, Hydraulic, Pneumatic and Electrical Drive Systems, Robotics Gears and Linkages. Interfacing, Simple Interfacing Link, Electrical, Mechanical Link, Input and Output Circuitry, Applications of Robots. CIMS, Computer integrated production management system, Engineering and Manufacturing Data Base. Material handling.

**MCE 4873      Solar Energy Conversion      3-0      Credit 3.00**

Solar thermal systems, flat plate collectors, concentrating collectors, storage, water heaters, air heaters, dryers, stills, pumps, engines, furnaces.

Solar photovoltaic systems, flat plate collectors, concentrating collectors, storage, water heaters, air heaters, dryers, stills, pumps, engines, furnaces.

Solar photovoltaic systems, silicon solar cells, cell efficiency, cell construction, modules and arrays, power conditioning, storage; thin film cells; applications for lifting water, lighting, telecommunication, cooling, etc.

**MCE 4880      Mechanical Engineering      0-3      Credit 1.50**  
**Lab-II**

Lab Experiments and Workshop Practice related to the courses of the Eighth Semester.

**MCE 4887      Fundamentals of Road      3-0      Credit 3.00**  
**Vehicle Dynamics**

Tire constructions and tire mechanics: rolling resistance, tractive and braking efforts, cornering and ride properties of tires. Longitudinal performances: acceleration, velocity and gradability of road vehicles. Brake system design; layout and power assisted braking, braking performance, ABS. Cornering performance of vehicle: Steering systems, steady-state performance and performance measures. Automotive transmissions design and engine transmission matching driving condition diagram. Vehicle suspension systems, ride quality models, ride analysis, driver comfort criterion, pavement load issues, and advanced suspension systems.

## Course Contents for Postgraduate Programmes

### **MCE 6100 Project Credit 6 hrs.**

The Project is to be registered as per the procedure of registration of other courses.

The maximum number credit hours is limited to 6 hrs for Projects. The Project work has to be conducted in the related field and to be carried out according to the procedure as laid out in the Rules and Regulations of the Postgraduate Programme in Engineering and Technology.

### **MCE 6200 Thesis Credit 18 hrs.**

The Thesis is to be registered as per the procedure of registration of other courses. The maximum number credit hours per semester is 12 hrs. The thesis is to be conducted in the related field and as per procedure laid out in the Rules and Regulations.

### **Math 6103 Advanced Mathematics 3-0 Credit 3.00**

Calculus of several variables, Multiple integration; Solution of linear and nonlinear equations; Eigen values and Eigen Vectors and their applications. Harmonic functions and its applications. Boundary value problems and its application to engineering problems. Wave equations and its application to engineering problems.

### **MCE 6103 Theory of Elasticity 3-0 Credit 3.00**

Introduction, Plane Stress and Strain, Equilibrium, Compatibility, St. Venant's Principle, Superposition, rectangular, polar and curvilinear coordinates, Stress-strain analysis in three dimensions. Stress Functions, Castigliano's Theorem, Reciprocal Theorem, Torsion of bars, Membrane Analogy, Bending of Bars, Shear Centre, Axisymmetric Problems, Rotating Disks, Thermal Stress.

### **MCE 6105 Mechanical Behaviour of Materials 3-0 Credit 3.00**

Introduction, Elastic Behaviour, Constitutive Relations, Dislocations, Plastic Deformations, Strengthening of crystalline materials, composite materials, High Temperature Deformation, Permanent Deformation, Brittle and Ductile Fracture, Fracture at low and high temperature, Fatigue, Creep-Fatigue Interaction, Embrittlement, Stress and strain concentration, Friction and Wear.

**MCE 6107 Experimental Stress Analysis      3-0      Credit 3.00**

Introduction, Stress-strain analysis, Principle of strain gauges, Resistance strain gauges, different arrangements of gauges, Strain measuring devices and recording. Residual stress. Photoelasticity, Fringes, Stress Calculation, Different Coating techniques, Brittle Lacquer methods, Analysis of results. Modern Methods of Stress and Strain Analysis.

**MCE 6109 Mechanical Vibrations                      3-0      Credit 3.00**

Introduction, Free and Forced Vibration, Single degree and multiple degree systems, Resonance, Lagrange Equation, Continua with infinite degree, Use of Finite Element Method, Vibration of plates, shells, Random Vibration, Measurement of Vibration, Isolation and control of vibration.

**MCE 6115 Inviscid Fluid Flow                              3-0      Credit 3.00**

The mechanics of inviscid fluid flows: governing equations of motion, kinematics and vorticity transport; Two- and Three-dimensional potential flow, complex potential, superposition, conformal transformations, Schwarz-Christoffel transformations, ideal flow aerodynamics.

**MCE 6117 Viscous Fluid Flow                              3-0      Credit 3.00**

Equations of motion for viscous fluid; Boundary layer analysis for laminar flow: Similarity solutions for steady two-dimensional flow, Rotationally symmetric boundary layers, Axisymmetric and three-dimensional boundary layer flow, Unsteady boundary layer and Separation of boundary layer. Boundary layer analysis for turbulent flow: The origin of turbulence, Reynolds equation and Reynolds stresses, the two-dimensional boundary layer equations, turbulent boundary layer on a flat plate, Turbulent flows in pipes and channels, Universal velocity distribution, Turbulent jets, wakes, and separated flows.

**MCE 6119 Turbomachinery                              3-0      Credit 3.00**

Introduction, Classical theories of turbomachinery and cascade aerodynamics. Two and three dimensional inviscid and viscous flows in turbomachinery. Aircraft engine compressors and turbines, spacecraft turbomachinery, industrial compressors, pumps and

turbines. Performance prediction, losses, efficiency and rotor noise of turbomachinery.

**MCE 6121 Advanced Topics In Manufacturing 3-0 Credit 3.00**

Recent development in manufacturing techniques, Modern manufacturing methods, and non-conventional metal-cutting techniques. Manufacturing techniques of parts of composite and non-metallic materials. Material selection and process selection techniques. Design recommendations for manufacturing. Basic principles of product development design and process engineering for economical production.

**MCE 6123 Expert Process Planning For Manufacturing 3-0 Credit 3.00**

Expert process planning as it is required for Industry. Recent development and future trend in CAPP. Design representation-methods and models. Design interface for process planning input. Process knowledge representation. Expert system formulation. QTC-as an Expert Process Planning System (Case study).

**MCE 6125 CIM And Database Management System 3-0 Credit 3.00**

Introduction; Concepts and methods in database system; Objectives of database; Disadvantages of database; Database requirement of CIM; Database management; Features in a database management system; Database administration; Database and traditional file system; Database model: Hierarchical and Network database; Relational database management system (RDBMS); DBMS architecture; Data manipulation; Query formulation and language; SQL in CIM; SQL as a knowledge base query language; Transaction management; Concurrency control.

**MCE 6127 Advanced Machine Tools Design 3-0 Credit 3.00**

General principle of machine tool design. Regulation of speed and feed rate. Design of machine tool structures. Design of guideways and power screws. Design of spindles and spindle supports. Dynamics of machine tools. Control system of machine tools. Numerical control of machine tools. Automatic, semiautomatic, and specialized machine tools. Machine center. Transfer machine.

**MCE 6145 Convective Heat Transfer 3-0 Credit 3.00**

Convection fundamentals. Forced convection, natural convection, transport equations, differential similarity, boundary layer and pipe flow solutions. Transport in rarefied gases. Condensation and evaporation, convective mass transfer.

**MCE 6147 Statistical Thermodynamics 3-0 Credit 3.00**

Kinetic theory of gases; Thermodynamic theory of radiation; Maxwell-Boltzman distribution, equation theorem; Mean free path; Einstein and Fermi-Dirac Statistics; Entropy transport properties; Fluctuation. Thermodynamics of noise.

**MCE 6153 Boiling and Condensation Heat Transfer 3-0 Credit 3.00**

Introduction; Boiling – Pool and forced convection, sub-cooled and saturated; fundamentals of two phase flow, mathematical and empirical methods, hydrodynamic instability; enhanced boiling heat transfer, estimation methods; burnt out; condensation-modes, gas phase heat and mass transfer, filmwise condensation on horizontal and inclined tubes and surfaces; condensation promoters.

**MCE 6161 Advanced Automatic Control 3-0 Credit 3.00**

Electronic, pneumatic, and hydraulic controllers. Static and dynamic error coefficients, Error criteria, system optimization. Lead, Lag, and Lag-lead compensation based on root locus and frequency response approaches. Nonlinear systems, functional analysis of nonlinear control Systems. Phase plane analysis of linear and nonlinear systems. State-space concept; variables & representation of systems, transfer matrix, linear time varying systems. Liapunov stability analysis of linear and nonlinear systems. Optimal and adaptive control systems. Digital control system.

**MCE 6201 Engineering Plasticity 3-0 Credit 3.00**

Introduction, Stress, Strain, Equilibrium Equations, Yield Criteria of Metals, Stress Strain Relations: Prandtl, Mises Equations. Flow Rules, Work Hardening characteristics, Elastic-Plastic Bending, Torsion of bars, Axi-symmetric elastic-plastic problems, Plastic Instability. Tube Sinking, Wire Drawing,, Rolling, Deep Drawing, Extrusion, Super Plasticity, Slip-line Field, Load Bounding.

**MCE 6207 Theory of Plates and Shells 3-0 Credit 3.00**

Introduction, Bending of rectangular plates, circular plates. Deflection of laterally loaded plates, Simply supported rectangular plates and with different edge conditions, Continuous rectangular plates, Plates with elastic foundation, Plates of various shapes. Special and approximate methods in Theory of plates, Bending of anisotropic plates, Large deflections of plates, Deformation of shells without bending.

**MCE 6209 Finite Element Method 3-0 Credit 3.00**

Introduction, Finite Elements of an elastic continuum, Generalization of the finite element concepts, Plane stress and plane strain, axi-symmetric stress analysis, three dimensional stress analysis, element shape function, curved, isoparametric elements, numerical integration, applications of isoparametric elements in two and three dimensional stress analysis. Bending of thin plates, axi-symmetric shells, computer programs for finite element analysis.

**MCE 6213 Turbulence 3-0 Credit 3.00**

Introduction to origin of turbulence, equations for Reynolds stresses, Estimation of Reynolds stresses for different boundary conditions, Homogeneous and isotropic turbulence, Correlation and statistical theory, Models for eddy structure, Frequency spectra and the energy cascade. Transport closure models using kinetic energy and dissipation.

**MCE 6221 Quality Assurance and Management 3-0 Credit 3.00**

Quality management. Quality assurance systems management. Quality assurance program audits and assessments. Quality program registration. Quality management and global competition. Future challenges and opportunities. Total quality control: concepts, principles and models. Bench marking.

**MCE 6223 Advanced Operations Research 3-0 Credit 3.00**

Advanced linear programming. Goal programming. Integer programming: formulations and industrial applications, solution methodologies, Branch and Bound method, cutting plane algorithm.

Probabilistic inventory models. Nonlinear programming: unconstrained optimization, constrained optimization.

**MCE 6225 Engineering Decision Analysis 3-0 Credit 3.00**

Decision analysis and its scope. Sources of complexity in decision problems. Decision making under uncertainty: non-stochastic and stochastic criteria, coherence principle, subjective probability evaluation, utility theory. Decision making in competitive environment. Multistage decision analysis: decision tree, research planning diagram, influence diagram. Multi-criteria decision making: multi-attribute models, analytical hierarchical process (AHP), additive and multiplicative utility models. Case problems.

**MCE 6229 Reliability Engineering and System Safety 3-0 Credit 3.00**

Reliability concepts. Failure distributions. Basic reliability models: constant failure rate models, time-dependent failure models. System reliability evaluation techniques: network reduction, path set, cut set, decomposition, delta-star transformation, markov process. Probabilistic approach to design – load-strength interference models. Reliability testing. Reliability optimization. System safety concepts. Safety programme planning and management. System safety analysis techniques: Preliminary hazard analysis, failure mode and effects analysis, Energy trace and barrier analysis, Project evaluation tree, Human reliability. Probabilistic risk assessment.

**MCE 6231 Technology Management 3-0 Credit 3.00**

Technology and civilization; Components of technology, their development and sophistication; Production of technology, innovation and its management life cycle intellectual property right (IPR), e-commerce, e-governance; Technology and development: Technology relevance to developed, developing and NIC countries, technology and environment, late development, management of technology at the firm level; Technology transfer: Modes and models of technology transfer, legal aspects, pricing of technology, export processing zone; Technology assessment and development planning; Technology of 21<sup>st</sup> century, Case studies.

**MCE 6241 Renewable Energy 3-0 Credit 3.00**

Introduction. Review of heat transfer process.  
Solar radiation. Estimation and measurements. Flat-plate collectors and concentrating collectors, energy balances equations. Collector efficiencies. Photovoltaic generation.

Hydro-energy. Calculations of power generated by turbines. Other application

Wind energy. Velocity Mapping. Analysis of wind turbines, dynamic matching.

Wave and tidal energy. Wave motion and patterns. Devices used for power generation. Causes of tides. Tidal flow and range powers.

Geothermal energy. Dry rock and hot aquifer analysis. Methods of harnessing energy.

Ocean thermal energy conversion. Heat exchangers. Pumping requirements. Practical considerations.

Biofuel energy. Direct combustion, pyrolysis, thermo chemical processes.

Energy storage and distribution. Importance, type of storages. Distribution methods.

**MCE 6243 Combustion Process 3-0 Credit 3.00**

Basic Concepts of flame propagation, Theory of Laminar and Turbulent diffusion flames, Burning velocity; Flame structure, quenching and flame stabilization. Thermal requirements of Ignition, extinction and combustion. Combustion aerodynamics. Burning gaseous and liquid fuel. Single droplet burning, burning of sprays. Solid fuel combustion Principles of operation, performance and mechanical design of burners and combustion chambers. Combustion noise and oscillation. Combustion in Power generations and manufacturing Energy and Waste heat recovery. Economy in the use of energy Nature and properties of the atmosphere pollutants, sources, methods of control. Stack design, auto mobile exhausts, monitoring, Air quality stands, legislation.



**MCE 6250 Special Topics 3-0 Credit 3.00**

Selected topics related to mechanical engineering; Assigned reading and special subjects arranged on individual basis in consultation with the teacher.

**MCE6321 Design Management & Prediction 3-0 Credit 3.00**

Introduction to Manufacturing Trends, Costs and Good Product Development; Integrated Product Development; Approaches to Integrated Product Development (Concurrent Engineering, Team Engineering, Decision Support);; Nature of Design and Design Process Models; Team Working and Organisational Structures; Design Complexities and Design Coordination; Design Performance; Innovation in Design; Design Process Optimisation; Collaborative and distributed Design.

**MCE 6323 Design Methodology, Techniques & Tools 3-0 Credit 3.00**

Introduction to Design Methods, Tools & Techniques; Artefact & Process Design Theories; The Basic Design Cycle; Tools & Methods For Design Problem Analysis (QFD, etc); Tools & Methods for Design Solution Synthesis (Morphological Charts, Brainstorming etc.); Tools & Methods For Solution Analysis & Evaluation (FMEA, Decision Matrices etc); Concept generation (Creative design) and evaluation methods; Detailed design methods; Project definition methods, PDS, QFD, Customer analysis etc; Design for X (Manufacture/Assembly, Disassembly, Use, Disposal/Reuse, Safety and Reliability etc.); Inclusive design and Emotional design; Computer support design methods, e.g. Expert systems, KBS etc.

**MCE 6325 CAD and Product Data Management 3-0 Credit 3.00**

.Introduction to industrial product development concepts and digital Mock-Up principles; CAD systems in industrial context (different CAD systems, implementation of CAD systems); Mathematical background on curves and surfaces representation (parametric representation, curvature, Bezier, Bspline and NURBS representation).;3D geometric representation (Surface and solid modelling techniques, BRep and CSG representation).;Capabilities of CAD systems (Parametric, Variational, history tree, feature

modelling, nonmanifold model).; Part and product modelling techniques (surface model definition, Boolean and feature modelling for solid model); Product data exchange standard for 3D modellers (IGES, STEP, etc.); Basic functionalities of PDM systems (product data structure, document management, user access management, etc.); Specification of PDM needs and implementation on industrial case study; Industrial challenges of collaborative product development and technological stakes from PDM towards PLM

**MCE 6327 Modelling, Simulation, and Visualization 3-0 Credit 3.00**

Computer Modelling Environment and its effect on Product Development; Function Modelling Techniques; Geometric Modelling, Finite Element Modelling & Analysis; Kinematic Modelling of Mechanisms; Dynamic Modelling & Analysis of Mechanical Systems; Simulation Fundamentals and Types; Computer graphics in product visualisation, Visualisation techniques; Web-based product modelling and visualisation,

**MCE 6329 Digital Manufacture and Rapid Manufacture 3-0 Credit 3.00**

Integrated product aspects modelling: Computer numerical control and machine tools. Multi-axis numerical control machining technology; High speed numerical control machining technology; Programme logical controller used in manufacturing processes.; Computer aided process planning.; Computer aided manufacture; Flexible manufacturing system.; Distributed numerical control.; Digital manufacturing methods and tools.; Contemporary integrated manufacturing..

**MCE 6351 Advanced Heat Transfer and Computational Fluid Dynamics (CFD) 3-0 Credit 3.00**

Advanced Heat Transfer: Heat Conduction; Heat Conduction-Rectangular and cylindrical Coordinates; Convective Heat Transfer: Fluid Dynamics Introduction; Convective Heat Transfer: Limiting Condition Flows; Convective Heat Transfer: Laminar Heat Transfer; Convective Heat Transfer: Turbulent Heat Transfer; Introduction to CFD; Discretization methods; Case studies to solve Heat Transfer problems; Advanced Mathematical Tools to Solve Transient Heat Conduction Problems



**MCE6427 Process Planning & Computer 3-0 Credit 3.00  
Aided Manufacturing (CAM)**

Introduction: Process planning and Product Lifecycle (introduction to CE, process planning definition process); Manufacturing processes and technologies (current and advanced techniques and machine technologies); Manufacturing processes selection and DFM (process classification, process selection, CES 4 software); CAM software and CAD/CAM data exchange (CAM software main functions, GOelan and CATIA software); Product analysis, process planning and fixturing and clamping systems definition and modelling (surfaces and tolerances analysis, part settings definition, manufacturing features definition; Machining operation and machining strategies definition, modelling and simulation (Facing, Hole, pocketing, HSM strategies); Cutting tools and machining parameters definition and selection (geometry, materials, cutting parameters and wear mechanisms); NC machine and post processing (technological evolutions, NC system, NC parameters settings, machine modelling); Control techniques and technologies (CMM machines, SPC, MSP, reverse engineering based control); Open issues and overview on manufacturing systems, and supply chain management (Storage management, workflow, Delmia software).

**MCE 6429 Design Optimization 3-0 Credit 3.00  
and Analysis**

Introduction to Design Optimization, Theory and Background; Design Optimization and Analysis using FEA ; Finite element modeling, meshing, boundary conditions and solution for analysis and practical design for both the structural and heat transfer problems (Linear and Non-Linear Analysis); Case studies and Design Verification using post processing; Model optimization, theory and background; Case studies.; Introduction to geometric modeling technology and associated computational geometry; A study of data exchange issues related to analysis and simulation; An overview of sensitivity studies and shape optimization; An insight into the analysis and simulation of different applications including plastic and composite components.



**MCE 4791    Engineering Economics                    2-0    Credit 2.00**

Introduction to engineering economic decision, cash flow analysis and basic concepts of discounting, cost of capital, required ROR equivalence.

Business mathematics: Investment appraisal criteria for economic decisions, present worth, internal rate of return, social consideration in investment, benefit-cost ratio

Decisions involving depreciation and inflation, taxes, sensitivity analysis.

## FOR M.Sc.TE PROGRAMME

**MCE 6101 Numerical Analysis 3-0 Credit 3.00**

Numerical solution of algebraic equations, empirical formulas and method of least squares, numerical differentiation and integration, numerical integration of differential equations, errors in numerical calculations.

**MCE 6113 Advanced Heat Transfer 3-0 Credit 3.00**

General conduction equation for anisotropic solids. Steady and unsteady conduction, analytical and numerical analysis of rings of non-uniform cross-section. Thermal radiation, heat exchange among gray bodies. Forced and natural convection, energy equation, external and internal flows, analytical and experimental results. Condensation and evaporation.

**MCE 6131 Quality Assurance 3-0 Credit 3.00**

Quality assurance functions, relationship to reliability. Organization of Quality assurance, Systems and Procedures, Motivation and Quality control. Quality audit; systems, procedures and organisation of audit, Control of Engineering quality, Control of quality during manufacture.

**MCE 6141 Operations Research 3-0 Credit 3.00**

Basic statistical concepts, Probability and reliability concepts. Confidence limit. Theory of sampling and sampling plans, sampling inspection. Linear Programming; general linear programming models. Scheduling; Network analysis, simulation.

**MCE 6151 Mass Transfer 3-0 Credit 3.00**

Study of mass transfer operations. Topics will include phase equilibria, molecular and turbulent diffusion, mass transfer coefficients and transfer units, theories of mass transfer, column hydrodynamics, plate efficiency, Multicomponent systems.

**MCE 6203 Applied Elasticity 3-0 Credit 3.00**

Stress and strain tensor, equations of equilibrium, compatibility, generalized Hook's law, Airy's stress function, Formulation of elasticity problems, St. Venant's principle, superposition, stress

concentrations, axisymmetric problems, rotating discs and cylinders. Thermal stresses; three dimensional problems. Extension, flexure, torsion, Reciprocal theorems; energy principles and variational methods.

**MCE 6205 Classical Thermodynamics 3-0 Credit 3.00**

Macroscopic and Microscopic point of view, Temperature concept. Thermodynamic systems. Work, quasi-static process. First law and second law of thermodynamics, Reversibility and irreversibility, entropy. Properties of pure substances, equations of state. Applications of thermodynamics, to pure substances and special systems, Equilibrium and stability.

**MCE 6227 Production Management 3-0 Credit 3.00**

Production organisations, organisation structure according to type of product, Systems engineering applied to production systems and organisations. Operational sub-systems. Factory Planning; concept; location, plant layout, layout of production equipment; material handling, Operation Research techniques for management decision. Human influences on productivity. Role of union. Collective bargaining, wage incentive plans.

**MCE 6233 Engineering Economics 3-0 Credit 3.00**

Investment cost, evaluation of investment proposals, capital budgeting. Capital recovery methods, compound interest concept, present worth factor, sinking fund, cost of borrowed money. Cost concepts, elements of production cost, economic lot sizes, profit, nature and measurement of profit, break-even point, pricing products. Demand theory, method of forecasting demand, Replacement of assets.



## FOR PGDTE PROGRAMME

**MCE 5100 Special Studies 0-4 Credit 2.00**

The students are required to undertake a project in the field of mechanical engineering in their respective specialization. The objective is to provide an opportunity to the students to develop initiative, creative ability, confidence and engineering judgement. The results of the work should be submitted in the form of a report.

**MCE 5103 Mechanical Behaviour of Engineering Materials 3-0 Credit 3.00**

Elastic and plastic behaviours in tension, compression, shear, bending and combined stresses. Cost, availability and characteristics of engineering materials. Ductile fracture, initiation and growth, Brittle fracture, crack formation and crack growth, Griffith's law of crack propagation. Creep mechanism, creep tests. Low and high temperature properties. Fatigue properties, mechanism of fatigue tests

**MCE 5111 Intermediate Fluid Mechanics 3-0 Credit 3.00**

Compressible flow through ducts of varying and uniform cross section. Potential flow, velocity potential and stream function, examples of ideal two dimensional steady flow. General continuity and Navierstokes equations, flow regimes and simple flow solutions, flow through passages, universal velocity distribution, flow over immersed bodies, boundary layer analysis.

**MCE 5121 Advanced Production Processes 3-0 Credit 3.00**

Selection of production processes, selection of machine tools, economics of jigs and fixtures. Different welding processes; unconventional welding technique; effects of welding on metal structure; design and joint preparation, testing of welded joints. Ferrous and non-ferrous casting; different types of iron castings; die casting investment casting and shell molding, principles of metal forming; metal forming processes; design of pressworking tools. Principles of manufacturing components from powdered material; capabilities and limitations of centered products.

**MCE 5127    Advanced Machine Tools            3-0    Credit 3.00**

Machine tool classification; selection criteria and acceptance tests; kinematic structure. Gear manufacturing machine tools; machine tools for cutting tools production; Automatic and semi-automatic machine tools; Static and dynamic rigidity of machine tools.

**MCE 5157    Corrosion Engineering            3-0    Credit 3.00**

Principles and applications of modern theory of corrosion. Pourbaix diagrams. High temperature corrosion. Corrosion in specific chemical processes and other industries, e.g., pollution control, waste treatment, coal conversion, desalination, aerospace, corrosion of surgical implants in human body. Methods and economics of corrosion protection. Uses of non-metallic materials.

**MCE 5200    Special Studies                            0-4    Credit 2.00**

The student are required to undertake a project in the field of mechanical engineering in their respective specialization. The objective is to provide an opportunity to the students to develop initiative, creative ability, confidence and engineering judgement. The results of the work should be submitted in the form of a report.

**MCE 5209    Thermal Environmental    3-0            Credit 3.00**  
**Engineering**

Fundamentals of refrigeration, vapour compression refrigeration system, absorption refrigeration system, cryogenics and others refrigeration systems, psychrometry, Evaporative cooling. Heating and cooling of moist air. Solar radiation and heat transfer in buildings. Air conditioning systems. Air handling and distribution systems.

**MCE 5213    Heat Transfer Equipment Design    3-0    Credit 3.00**

Review and study of related theories of heat, mass and momentum transfer. Different types of heat transfer equipments, fouling. Analysis and design of heat transfer equipments.

**MCE 5221    Plastics Process Engineering            3-0    Credit 3.00**

Introduction, Classification of Polymers, Molecular Weight Distribution, Polymerization, Co-polymerization. Additives and Compounding, Properties of plastics, Processing of Plastics,

Extrusion: Basic Single Screw Extruder, Screw parameters, Material Characteristics, Principles of Die design. Complete Extrusion Process: Pipe, Film, Solid section, Monofilament, Wire Coating, Multiscrew Extruders. Injection Molding: Construction and Operation, Screw Design, Specification. Clamping system, Calculation of clamping force; Hydraulic system. Injection Mould and Materials, Control systems. Blow, Compression, Transfer Moulding. Calendering. Forming: Vacuum, Thermo. Glass Reinforced plastics; Identifications of Plastics.

**MCE 5231 Designing for Production 3-0 Credit 3.00**

Product specification formulation; customer's requirement, alternative solutions and their evaluation, Design considerations; function appearance, economy. Design methods; economic factors of design; general design rules, Tolerances; achieving large machining tolerances; effect of tolerance on product cost. Design features to facilitate machining tolerances; effect of tolerance on product cost. Design features to facilitate machining; functional and manufacturing datum faces. Component design considerations-casting, welding, machining, assembly and material standardisation in product design.



**For course details of the following courses see the section for courses of MCE students**

<b>Course Number</b>	<b>Course Title</b>	<b>Contact Hours</b>	<b>Credit Hours</b>
Math 4303	Mathematics – III	4 - 0	4.00
Math 4403	Mathematics – IV	3 - 0	3.00
Math 4404	Mathematics Practice – IV	0- 3/2	0.75
MCE 4503	Mechanics of Materials	4 - 0	4.00
MCE 4504	Mechanics of Materials Lab	0 - 3/2	0.75
MCE 4505	Fluid Machinery	3 - 0	3.00
MCE 4506	Fluid Machinery Lab	0 - 3/2	0.75
MCE 4507	Control and Automation	2 - 0	2.00
MCE 4508	Control and Automation Lab	0 - 2	1.00
MCE 4603	Mechanics of Machines	3 - 0	3.00
MCE 4604	Mechanics of Machines Lab	0 - 3/2	0.75
MCE 4627	Machine Tools	2 - 0	2.00
MCE 4628	Machine Tools Practice	0 - 2	1.00
MCE 4639	Machine Design - I	3 - 0	3.00
MCE 4640	Machine Design Practice - I	0 - 2	1.00
MCE 4700	Project & Thesis – I	0 – 6	3.00
MCE 4705	Thermodynamics – III	3 – 0	3.00
MCE 4711	Fluid Mechanics – III	3 – 0	3.00
MCE 4721	Manufacturing System & Automation	3 – 0	3.00
MCE 4739	Machine Design – II	3 – 0	3.00
MCE 4771	Energy Conservation & Management	3 – 0	3.00
MCE 4800	Project & Thesis – II	0 – 6	3.00
MCE 4803	Vibration and System Dynamics	3 – 0	3.00
MCE 4813	Heat & Mass Transfer	3 – 0	3.00
MCE 4821	Design for Manufacturing	3 – 0	3.00
MCE 4827	Production Planning & Control	3 – 0	3.00
MCE 4873	Solar Energy Conversion	3 – 0	3.00

## FOR B.ScTE (1-YEAR) PROGRAMME

For course details of the following courses see the section for BScTE (2-year programme).

Course Number	Course Title	Contact Hours	Credit Hours
MCE 4753	Refrigeration & Air-Conditioning-I	3 – 0	3.00
MCE 4785	Automotive Engineering I	3 – 0	3.00
MCE 4853	Refrigeration & Air-Conditioning-II	3 – 0	3.00
MCE 4885	Automotive Engineering II	3 – 0	3.00

For course details of the following courses see the section for courses of MCE students.

Course Number	Course Title	Contact Hours	Credit Hours
MCE 4700	Project & Thesis – I	0 – 6	3.00
MCE 4705	Thermodynamics – III	3 – 0	3.00
MCE 4711	Fluid Mechanics – III	3 – 0	3.00
MCE 4721	Manufacturing System & Automation	3 – 0	3.00
MCE 4739	Machine Design – II	3 – 0	3.00
MCE 4771	Energy Conservation & Management	3 – 0	3.00
MCE 4800	Project & Thesis – II	0 – 6	3.00
MCE 4803	Vibration and System Dynamics	3 – 0	3.00
MCE 4813	Heat & Mass Transfer	3 – 0	3.00
MCE 4821	Design for Manufacturing	3 – 0	3.00
MCE 4827	Production Planning & Control	3 – 0	3.00
MCE 4873	Solar Energy Conversion	3 – 0	3.00

## FOR DTE PROGRAMME

For course details of the following courses see the section for courses of MCE students.

Course Number	Course Title	Contact Hours	Credit Hours
MCE 4551	Refrigeration	3-0	3.00
MCE 4552	Refrigeration Lab	0-3/2	0.75
MCE 4555	Control System Technology	3-0	3.00
MCE 4556	Control System Technology Lab	0-3/2	0.75
MCE 4573	Renewable Energy Resources	3-0	3.00
MCE 4574	Renewable Energy Resources Lab	0-3/2	0.75
MCE 4585	Automotive Technology I	3-0	3.00
MCE 4586	Automotive Technology Practice I	0-3/2	0.75
MCE 4587	Automotive Maintenance Engineering I	3-0	3.00
MCE 4588	Automotive Maintenance Engineering Practice I	0-3/2	0.75
MCE 4651	Plant Operation & Maintenance	3-0	3.00
MCE 4652	Plant Operation & Maintenance Lab	0-3/2	0.75
MCE 4653	Air-Conditioning	3-0	3.00
MCE 4654	Air-Conditioning Lab	0-3/2	0.75
MCE 4671	Fossil Fuel Engineering	3-0	3.00
MCE 4672	Fossil Fuel Engineering Lab	0-3/2	0.75
MCE 4685	Automotive Technology II	3-0	3.00
MCE 4686	Automotive Technology Practice II	0-3/2	0.75
MCE 4687	Automotive Maintenance Engineering II	3-0	3.00
MCE 4688	Automotive Maintenance Engineering Practice II	0- 3/2	0.75

