



MANIPAL UNIVERSITY  
JAIPUR

List of Course Hand-outs  
(Odd and Even Semester)

Department of Mechatronics Engineering

SAMM

Manipal University Jaipur (RJ)



MANIPAL UNIVERSITY  
JAIPUR

## MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Mechatronics Engineering

### PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

#### PROGRAM OUTCOMES

**[PO.1]. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

**[PO.2]. Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

**[PO.3]. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

**[PO.4]. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

**[PO.5]. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

**[PO.6]. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

**[PO.7]. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

**[PO.8]. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices

**[PO.9]. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

**[PO.10].Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

**[PO.11]. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

**[PO.12].Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

**[PSO.1]** Apply the knowledge of basic sciences, analytical skills and modern computing tools to design, perform and analyze experiments to meet desired goals within the given constraints.

**[PSO.2].** Apply concepts of circuit analysis, analog and digital electronics, controls, electric drives, instrumentation, power systems, machine learning and artificial intelligence to design and automation of mechatronics systems.

**[PSO.3].** Use the principles of solid mechanics, fluid mechanics, strength of materials, advanced functional materials and manufacturing processes to design, manufacture, and commissioning of mechatronics systems.

# PROGRAM ARTICULATION MATRIX

EVEN SEMESTER	COURSE CODE	PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES														
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
<b>I</b>	PY 1101	2	2	-	3	2	2	3	-	3	3	3	-	-	1	-
	MA 1101	3	3	3	2	1	-	1	-	-	1	-	1	1	-	-
	ES 1101	2	3	2	3	1	3	3	3	3	3	2	3	1	-	-
	EC 1101	3	3	3	2	1	1	1	-	-	1	-		-	-	-
	ES 1102	3	3	-	-	-	-	-	-	-	-	-	3	-	-	1
	ME 1101	3	3	3	2	3	-	-	-	-	-	-	3	3	-	-
<b>II</b>	CY 1101	2	2	2	-	2	-	2	1	-	2	-	3	-	-	-
	MA 1201	3	3	3	2	1	-	1	-	-	1	-	1	1	-	-
	EE 1101	3	2	1	-	-	1	-	-	-	-	-	2	-	-	-
	CS 1101	3	1	3	-	-	-	-	-	-	-	-	3	1	-	-
	EN 1111	1	1	-	-	-	-	-	1	-	-	-	1	-	-	-
	ES 1103	3	3	3	2	-	2	2	-	-	-	-		-	-	1
	HS 1102	-	-	3	-	-	3	2	1	-	-	-	3	-	-	-
<b>III</b>	MCI306	3	2	3	3	3	0	0	0	0	0	0	0	2	1	3
	MCI307	3	0	3	0	3	0	0	0	0	0	0	0	1	3	0
	MCI308	3	2	2	2	2	0	0	0	0	0	0	1	1	3	0
	MCI309	3	3	2	3	0	0	0	0	0	0	0	0	3	0	2
	MAI313	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	EOI323	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>IV</b>	HSI301	-	-	3	-	-	3	2	1	-	-	-	3	-	-	-
	MAI410	2	-	-	1	1	-	-	-	-	2	-	-	1	2	1
	MCI405	3	2	3	3	3	-	-	-	-	-	-	-	2	-	3
	MCI406	1	-	2	-	1	-	-	-	-	-	-	-	2	3	-
	MCI407	2	2	3	3	2	1	1	-	1	1	2	1	3	2	3
	MCI492	1	2	2	-	-	-	-	-	-	3	3	-	2	-	-
	MCI493	3	2	2	-	2	-	1	1	-	-	-	-	2	2	-
<b>V</b>	MCI507	3	2	3	3	3	0	0	0	0	0	0	0	3	3	0
	MCI508	1	2	3	3	1	2	1	0	1	0	1	0	1	3	1
	MCI509	3	2	3	2	3	3	2	1	2	1	1	3	3	3	1
	BBI540	3	3	2	3	0	0	0	0	0	0	0	0	3	0	2
	MCI550	3	3	2	0	3	0	0	0	2	0	1	2	3	3	0
	MCI551	3	2	2	0	1	1	1	1	1	1	1	2	2	1	1
	MCI552	3	2	2	2	3	2	0	2	3	1	2	0	2	0	3
<b>VI</b>	MCI605	3	2	2	3	-	-	-	-	-	-	-	-	2	2	-
	MCI606	3	3	2	-	-	2	3	2	2	3	2	2	3	2	3
	MCI607	2	3	2	1	3	1	-	-	-	-	-	-	2	2	3
	MCI608	2	2	1	2	2	1	1	-	1	2	-	-	2	2	1
	MCI654	3	2	2	2	2	2	-	2	3	1	2	-	-	-	-
	MCI655	3	2	3	3	3	-	-	-	-	-	-	-	3	3	-
	MCI656	3	-	-	2	3	2	-	2	3	-	2	-	-	-	3
	MCI694	3	2	2	3	2	2	-	-	-	-	1	-	-	2	2

<b>VII</b>	MCI706	2	2	2	2	3	0	0	0	0	0	0	0	3	2	0
	MCI707	2	3	3	2	1	2	0	0	1	0	3	0	1	1	1
	MCI704	3	2	2	0	0	2	1	0	3	1	0	1	3	2	0
	MCI755	3	2	2	2	2	1	0	0	0	0	0	1	3	2	3
	MCI756	1	3	2	2	2	1	0	0	1	0	0	0	2	2	2
	MCI757	3	2	3	0	3	0	0	0	0	0	0	0	1	3	0
	MCI758	2	2	2	2	3	0	0	0	0	0	0	0	2	2	0
	MCI759	3	2	2	0	2	2	2	1	1	2	1	2	1	1	1
	MCI761	3	2	2	2	3	2	0	2	3	1	2	0	1	0	3
	MCI762	3	2	2	3	3	0	2	0	0	0	0	0	3	3	0
<b>VIII</b>	MCI881	-	3	3	3	2	2	2	-	3	-	3	3	2	3	3



# MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Mechanical Engineering  
Course Hand-out

Basic Workshop Practice| ME 1030 | I Credits

Session: JUL 19 – NOV 19 | Faculty: Ashish Sharma

**A. Introduction:** This course is offered by Dept. of Mechanical Engineering which focuses on mainly hands on learning based on various working shops like lathe machine, welding, engines, UTM, residential wiring design, power supply and building plan. This course gives an overview of fundamental working of various machine tools, compressive strength of building materials and electrical- electronics instruments.

**B. Course Outcomes:** At the end of the course, students will be able to

**ME1030.1** Understand about the various measuring, marking and cutting tools and Comprehend the safety measures required to be taken while using tools.

**ME1030.2** Acquire skills and Knowledge about lathe machine, welding machines and 2S-4S engines and their operations.

**ME1030.3** Learn different techniques for quality assurance check of building materials.

**ME1030.4** Analyse the profile of existing ground for any infrastructure development project

**ME1030.5** Understand about the basic construction and working principle of fluorescent lamp, ceiling fan and three Phase Induction machine

**ME1030.6** Analyse the characteristics of different electronic components and CRO.

## C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

**[PO.1]. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

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#### D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Job preparation-	30
	File/Records-	15
	Viva-	15
End Term Exam (Summative)	End Term Exam (External Practical Exam)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup class on the job done on the day of absence will be given which has to be completed within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These jobs are limited to a maximum of 2 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

#### E. SYLLABUS

1. Study of parts of lathe machine and lathe operations
2. Perform different operations on lathe machine like Facing, Turning, Taper Turning and knurling on MS cylindrical work piece
3. Study of types of welding process and perform welding of different types of joint on MS plate with arc welding process
4. Study of two stroke and four stroke engines.
5. Layout of a small building plan on ground.
6. Levelling around Academic block.
7. Measurement of tensile strength of reinforcement bar using UTM.
8. Measurement of compressive strength of Brick/Cement by CTM.
9. Designing of residential wiring and study of three phase induction motor.
10. Study of the working of fluorescent lamp and ceiling fan.
11. Use of electronic Instruments and tools.
12. Building DC Regulated Power Supply.

#### F. TEXT BOOKS

- i. Hajra Choudhury S. K and Bose S. K, Elements of Workshop Technology, Vol I, Media
- ii. Promoters & Publishing Pvt. Ltd., Mumbai, 2012.

- iii. Raghuvanshi S.S, Workshop Technology, Dhanpat Rai and Sons, Delhi, 2002.
- iv. Punmia B. C, Surveying, Laxmi Publications, Bangalore, 2012.
- v. Uppal S.L., Electrical Wiring, Estimating and Costing, Khanna Publishers, 1978.
- vi. Bishop Owen, Electronics: A First Course, (2e), NEWNES, An Imprint of Elsevier, 2006.

**Lecture Plan:**

<b>Lec No</b>	<b>Topics</b>	<b>Session Outcome</b>	<b>Mode of Delivery</b>	<b>Corresponding CO</b>	<b>Mode of Assessing the Outcome</b>
1	Study of parts of lathe machine and lathe operations	Understanding building of tools and lathe machines	Lecture+Lab	I030.1	Lab Experiment
2	Perform different operations on lathe machine like Facing, Turning, Taper Turning and knurling on MS cylindrical work piece	Performance of different operations	Lecture+Lab	I030.1	Lab Experiment
3	Study of types of welding process and perform welding of different types of joint on MS plate with arc welding process	Understanding of welding processes	Lecture+Lab	I030.2	Lab Experiment
4	Study of two stroke and four stroke engines.	Knowledge of IC engines	Lecture+Lab	I030.2	Lab Experiment
5	Layout of a small building plan on ground.	Understanding of building layout	Lecture+Lab	I030.3	Lab Experiment
6	Levelling around Academic block.	Have information regarding levelling	Lecture+Lab	I030.3	Lab Experiment
7	Measurement of tensile strength of reinforcement bar using UTM.	UTM experiment	Lecture+Lab	I030.4	Lab Experiment
8	Measurement of compressive strength of Brick/Cement by CTM.	CTM experiment	Lecture+Lab	I030.4	Lab Experiment
9	Designing of residential wiring and study of three phase induction motor.	Gain knowledge about residential wiring	Lecture+Lab	I030.5	Lab Experiment
10	Study of the working of fluorescent lamp and ceiling fan.	Study of lamp and ceiling fan	Lecture+Lab	I030.5	Lab Experiment

I1	Use of electronic Instruments and tools.	Analyze the characteristics of different electronic components and its applications.	Lecture+Lab	I030.6	Lab Experiment
I2	Building DC Regulated Power Supply.	Understanding of small circuits.	Lecture+Lab	I030.6	Lab Experiment

**G. Course Articulation Matrix: (Mapping of COs with POs)**

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES											
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
MEI030.1	Understanding about the various measuring, marking and cutting tools and Comprehend the safety measures required to be taken while using tools.	I				I		I		I			I
MEI030.2	Acquire skills and Knowledge about lathe machine, welding machines and 2S-4S engines and their operations.		I							I			
MEI030.3	Learn different techniques for quality assurance check of building materials.	I	I			I							I
MEI030.4	Analyse the profile of existing ground for any infrastructure development project	I				I				I			I
MEI030.5	Understand about the basic construction and working principle of fluorescent lamp, ceiling fan and three Phase Induction machine	I				I				I		I	I
MEI030.6	Analyze the characteristics of different electronic components and CRO.	I	I					I		I			I

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**



# MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Physics

Course Hand-out

Engineering Physics | PY1001 | 4 Credits | 3 | 0 | 4

Session: July- Nov, 2019 | Faculty: Dr. Saikat | Class: B.Tech. I Sem.

**A. Introduction:** The mission of the Engineering Physics course is to prepare students for careers in engineering where physics principles can be applied to the advancement of technology. The course work will develop sufficient depth in physics skills to produce engineers who can relate fundamental physics to practical engineering problems, and will possess the versatility to address new problems in our rapidly changing technological base. The present course is meant to provide a more thorough grounding in applied physics for a selected specialty such as optics, quantum physics, atomic & molecular physics and solid-state physics. The discipline is also meant for cross-functionality and bridges the gap between theoretical science and practical engineering. It is notable the term “engineering physics” is also called as “technical physics” in several universities and colleges.

**B. Course Objectives:** At the end of the course, students will be able to

[1001.1] identify clearly the wide range of diversity in science and technology with the help of knowledge of the basic Physics.

[1001.2] justify and explain various processes involved in understanding the nature of light.

[1001.3] categorize and investigate the problems and applications of quantum physics.

[1001.4] understand and relate the fundamentals of quantum mechanics and apply the skills to solve one dimensional motion of particles.

[1001.5] impart the knowledge of empirical laws based on Solid State Physics and Atomic and Molecular Physics.

[1001.6] develop skills in imparting practical knowledge to real time solution of industrial problems

## C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1] **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

[PO.2] **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

[PO.3] **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

[PO.4] **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

[PO.5] **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

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**[PO.11] Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

**[PO.12] Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

#### D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	20
	Sessional Exam II (Closed Book)	20
	In class Quizzes and Assignment (Accumulated and Averaged)	20
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

#### E. SYLLABUS

**Optics:** Two source interference, double slit interference, coherence, intensity in double slit interference, thin film interference, air-wedge, Newton's rings, Michelson's interferometer, diffraction and wave theory of light, single-slit diffraction, intensity in single-slit diffraction (using phasor method), diffraction at a circular aperture, double-slit interference and diffraction, combined-intensity in double-slit diffraction (qualitative approach), diffraction of light through multiples slits, diffraction gratings, dispersion and resolving power of gratings, polarization of electromagnetic waves, polarizing sheets, polarization by reflection, double refraction; **Quantum Physics:** Black body radiation and Planck's hypothesis, Stefan's Law, Wein's displacement law, Photoelectric effect, Compton effect, photons and electromagnetic waves, wave properties of particles, de Broglie hypothesis, Davisson-Germer experiment, quantum particle (wave packet, phase velocity, group velocity), the uncertainty principle; **Quantum Mechanics:** An interpretation of quantum mechanics, wave function and its significance, Schrödinger equation, particle in a box, particle in a well of finite height (qualitative), Tunneling through a potential barrier and its applications, the simple harmonic oscillator (qualitative); **Atomic Physics & Molecular Physics:** Atomic spectra of gases, energy states and spectra of molecules (rotational and vibrational energy levels), X-rays spectrum, Moseley's law, spontaneous and stimulated transitions, He-Ne and Ruby laser, application of lasers; **Solid State Physics:** band theory of solids, electrical conduction in metals, insulators and semiconductors, Superconductivity, type-I and type-II superconductors, Meisner effect, BCS theory (Introductory) and applications of superconductivity.

#### F. TEXT BOOKS

1. Halliday, Resnick, Krane, PHYSICS, Volume 2, 5<sup>th</sup> edition, John Wiley & Sons, Inc, 2011
2. Beiser & Mahajan, Modern Physics, Mc Graw Hill, 6<sup>th</sup> edition., 2009

**G. REFERENCE BOOK**

Serway & Jewett, PHYSICS for Scientists and Engineers with Modern Physics; Volume 2, 6<sup>th</sup> edition, 2013

**H. Lecture Plan:**

Lec. No.	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode Assessing of the Outcome
1	Discussion of Lecture Plan	To acquaint and clear teachers expectations and understand student expectations	Lecture	<b>1001.1</b>	NA
2	Introduction to OPTICS	To make the student understand the difference between physical and geometrical optics. Recall elementary idea of transverse and longitudinal waves. Develop mathematical representation of waves.	Flipped Classroom	<b>1001.1 &amp; 1001.2</b>	In Class Quiz (Not Accounted)
3	Interference of light, Young's double slit interference, coherence	Understanding of the concept of coherent waves and interference	Lecture	<b>1001.2</b>	Class Quiz – I Home Assignment - I Mid Term I End Term
4	Intensity in double slit interference using Phasor method	Derivation of the formula for intensity distribution in double slit interference	Lecture	<b>1001.2</b>	Class Quiz – I Home Assignment - I Mid Term I End Term
5	Interference in thin film, antireflection coatings	Understand the concept of thin-film interference	Lecture	<b>1001.2 &amp; 1001.6</b>	Class Quiz – I Home Assignment - I Mid Term I End Term
6	TUTORIAL: I		Activity (Think Pair Share)		
7	Interference in wedge shaped air film	Understand the concept of interference in wedge shaped films and introduction to Newton's ring	Lecture	<b>1001.2 &amp; 1001.6</b>	Class Quiz – I Home Assignment - I Mid Term I End Term
8	Newton's rings – theory and experiment	Describe the Newton's ring experiment and develop the theory of Newton's ring	Lecture	<b>1001.2</b>	Class Quiz – I Home Assignment - I Mid Term I End Term
9	<b>TUTORIAL: 2</b>		Activity (Think Pair Share)		

			Share)		
10-11	Michelson interferometer – construction & theory (Qualitative approach only), Applications of Michelson interferometer (determination of wavelength)	Description of Michelson interferometer and derivation of the formula for determination of wavelength using it.	Lecture	<b>1001.2</b>	Class Quiz – 1 Home Assignment - 1 Mid Term I End Term
12	<b>TUTORIAL: 3</b>		Activity (Think Pair Share)		
13-14	Diffraction and wave theory of light, Fraunhofer diffraction at single slit – theory and intensity distribution	Introduction to diffraction and understand the difference between Fraunhofer and Fresnel diffraction	Lecture, Activity	<b>1001.2</b>	Class Quiz – 2 Home Assignment- 2 Mid Term I End Term
15-16	Analysis by Phasor method, Intensity distribution curve, Diffraction at a circular aperture	Develop the theory and formula for single slit diffraction	Lecture	<b>1001.2</b>	Class Quiz – 2 Home Assignment - 2 Mid Term I End Term
17	<b>TUTORIAL:4</b>		Activity (Think Pair Share)	<b>1001.2</b>	
18	Fraunhofer diffraction at double slit – theory (Qualitative approach only) and intensity distribution	Qualitatively develop the formula for intensity distribution in double slit diffraction	Lecture	<b>1001.2</b>	Class Quiz – 2 Home Assignment - 2 Mid Term I End Term
19	Fraunhofer diffraction at multiple slit – theory and intensity distribution, Diffraction grating	Understand the multiple slit diffraction pattern and diffraction grating	Lecture	<b>1001.2</b>	Class Quiz – 3 Home Assignment- 2 Mid Term I End Term
20	<b>TUTORIAL:6</b>		Activity (Think Pair Share)	<b>1001.2</b>	
21	Rayleigh's criteria of resolution, Dispersion and resolving power of grating	Understand the Raleigh's criteria for resolution and derive the expression for dispersive and resolving power	Lecture	<b>1001.2</b>	Class Quiz – 3 Home Assignment- 2 Mid Term I End Term

22	<b>TUTORIAL:7</b>		Activity (Think Pair Share)	<b>1001.2</b>	
23-24	Polarization of EM Waves, Polarizing sheets, Polarization by reflection, Double refraction, Malus law & Brewsters law	Understand the phenomena of polarisation and different approaches to polarise EM waves	Lecture	<b>1001.2</b>	Class Quiz – 3 Home Assignment - 3 Mid Term I End Term
25	<b>TUTORIALS: 8</b>		Activity (Think Pair Share)	<b>1001.2</b>	
26-27	Black body radiation , Wein's law, Stefan-Boltzmann law, Raleigh-Jeans Law, UV Catastrophe, Planck's hypothesis and Planck's law of black body radiation	Understand the laws of Black Body radiation and introduction to Planck's hypothesis	Flipped Class, Lecture	<b>1001.1 &amp; 1001.3</b>	Class Quiz – 4 Home Assignment - 4 Mid Term II End Term
28-29	Photoelectric effect, Experimental observations of Photoelectric effect, Compton effect ( Qualitative approach)	Describe the theory of Photoelectric effect and Compton effect	Lecture	<b>1001.1 &amp; 1001.3</b>	Class Quiz – 4 Home Assignment - 4 Mid Term II End Term
30	<b>TUTORIAL:9</b>		Activity (Think Pair Share)	<b>1001.3</b>	
31	Photons and electromagnetic waves, de-Broglie hypothesis of matter wave, Davisson-Germer Experiment	Understand the concept of de-Broglie hypothesis and describe the Davission-Germer Experiment	Lecture	<b>1001.1 &amp; 1001.3</b>	Class Quiz – 5 Home Assignment - 4 Mid Term II End Term
32-33	Quantum particle, Concept of wave packet. Group and phase velocity, Relation between $V_g$ & $V_p$ in dispersive medium, Uncertainty	Understand the Group Velocity and Phase Velocity and the concept of Uncertainty Principle	Flipped Classroom, Lecture	<b>1001.3</b>	Class Quiz – 5 Home Assignment - 5 Mid Term II End Term

	Principle (Statement and expression only) and its Physical significance				
34	<b>TUTORIAL: 10</b>		Activity (Think Pair Share)	<b>1001.3</b>	
35	An Interpretation of Quantum mechanics, Wave function and its physical significance, Schrödinger wave equation	Introduction to wave function and Schrodinger wave equation	Lecture	<b>1001.3</b>	Class Quiz – 5 Home Assignment - 5 Mid Term II End Term
36	Particle in a box of infinite potential height	Derive the wave-function and energy of a particle confined in a one dimensional box	Lecture	<b>1001.3</b>	Class Quiz – 6 Home Assignment - 5 Mid Term II End Term
37	<b>TUTORIAL: 11</b>		Activity (Think Pair Share)	<b>1001.3</b>	
38-39	Particle in a well of finite height ( qualitative), Tunnelling through a potential barrier ( qualitative) and its applications	Qualitatively describe the phenomena of particle in a finite well and the phenomena of tunnelling	Lecture	<b>1001.3</b>	Class Quiz – 6 Home Assignment - 5 Mid Term II End Term
40	Quantum mechanical simple harmonic oscillator ( Qualitative)	Qualitative discussion of the wave function and energy of a harmonic oscillator	Lecture	<b>1001.1 &amp; 1003.4</b>	Class Quiz – 6 Home Assignment - 5 Mid Term II End Term
41	<b>TUTORIAL: 12</b>		Activity (Think Pair Share)		
42-43	Bohr's Theory, Atomic Spectra of gases, Continuous and characteristic X-rays, Duane – Hunt relation, Moseley's law	Recall Bohr's theory and atomic spectra. Understand the continuous and characteristic X-rays and derive the related formula.	Flipped Classroom, Lecture	<b>1001.1 &amp; 1001.4</b>	Class Quiz (Not Accounted) Home Assignment - 6 End Term
44-45	Energy states and spectra of molecules ( Rotational and Vibrational spectra)	Qualitative discussion of Rotational and Vibrational spectra and the related formulas	Lecture	<b>1001.4</b>	Class Quiz – 7 Home Assignment - 6 End Term

46	<b>TUTORIAL: 13</b>		Activity (Think Pair Share)		
47	Lasers- Spontaneous and stimulated transitions, Population inversion and metastable state,	Understand the lasers and the related optical phenomena.	Lecture	<b>1001.4</b> <b>1001.5</b>	<b>&amp;</b> Class Quiz – 7 End Term
48-49	Construction and working of Ruby laser , Construction and working of He-Ne laser, Energy level diagram of He-Ne laser, Application of Laser	Description of Ruby laser and He-Ne laser and understand their working	Flipped Classroom, Lecture	<b>1001.5</b>	Class Quiz – 7 End Term
50	<b>TUTORIAL: 14</b>		Activity (Think Pair Share)		
51	Band Theory of solids, Electrical conduction in Metals, Insulators, and Semiconductors	Understand qualitatively the band theory of solids	Lecture	<b>1001.5</b> <b>1001.6</b>	<b>&amp;</b> Class Quiz – 8 End Term
52-53	Superconductivity: Type- I and Type- II Superconductivity, Meisner effect	Introduction to super conductivity and superconductors and the related phenomena	Lecture	<b>1001.5</b> <b>1001.6</b>	<b>&amp;</b> Class Quiz – 8 End Term
54	<b>TUTORIAL: 15</b>		Activity (Think Pair Share)		
55	BCS Theory ( Introductory) and Applications of superconductivity	Qualitatively understand the BCS theory and their applications	Lecture	<b>1001.5</b> <b>1001.6</b>	<b>&amp;</b> Class Quiz – 8 End Term
56	<b>TUTORIAL: 16</b>		Activity (Think Pair Share)		

#### I. Course Articulation Matrix: (Mapping of COs with POs and PSOs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES															
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12				
PY 1001.1	understand the wide range of diversity in science and technology with the help of knowledge of the basic Physics.	3	2			1	2	1	2		2		1				
PY 1001.2	explain various processes involved in understanding the nature of light.	3	3	3	2	2	2		1	1	2		2				
PY 1001.3	identify the problems and applications of Quantum Physics.	1		3		1			1	2			2				
PY 1001.4	fundamentals of quantum mechanics and apply to one dimensional motion of particles	2	3	3				1		2	1		2				
PY 1001.5	impart the knowledge of empirical laws based on Solid state Physics and Atomic and Molecular Physics.				1		1	2		1		2	2				
PY 1001.6	develop skills in imparting practical knowledge to real time solution of industrial problems	2	1		2	1		2	1		2	1					

I- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation



# MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Physics

Course Hand-out

Engineering Physics Lab | PY1030 | I Credit | 0 0 2 I

Session: July- Nov, 2019 | Faculty: Dr. Saikat | Class: B. Tech. I Sem.

**A. Introduction:** The mission of the Engineering Physics course is to prepare students for careers in engineering where physics principles can be applied to the advancement of technology. The course work will develop sufficient depth in physics skills to produce engineers who can relate fundamental physics to practical engineering problems, and will possess the versatility to address new problems in our rapidly changing technological base. The present course is meant to provide a more thorough grounding in applied physics for a selected specialty such as optics, quantum physics, atomic & molecular physics and solid-state physics. The discipline is also meant for cross-functionality and bridges the gap between theoretical science and practical engineering. It is notable the term "engineering physics" is also called as "technical physics" in several universities and colleges.

**B. Course Objectives:** At the end of the course, students will be able to

[1030.1] clearly explain the different type of errors like backlash error, parallax etc.

[1030.2] assess the behaviour of basic instruments like Vernier Callipers, screw gauge, spherometer and spectrometer etc and it will enhance their skills to use them.

[1030.3] acquire, analyse and process experimental data.

[1030.4] compare and contrast the facts and ideas in handling the practical applications of light, electricity sound and modern physics.

[1030.5] acquire hands on skills on diverse experimental tools related to physics that are essential for engineering students

## C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1] **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

[PO.2] **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

[PO.3] **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

[PO.4] **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

[PO.5] **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

[PO.6] **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

[PO.7] **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

[PO.8] **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices

**[PO.9] Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

**[PO.10] Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

**[PO.11] Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

**[PO.12] Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

#### D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Continuous Assessment/Viva	60
End Term Exam (Summative)	End Term Exam	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

#### E. SYLLABUS

Experiments on interference, diffraction and dispersion, experiments on quantum theory of radiation, Experiments on band theory of solids, semiconductors, Experiments on resonance circuits, Hall-effect.

#### F. TEXT BOOKS

1. Jewett & Serway, PHYSICS for Scientists and Engineers with Modern Physics (7e), Cengage Learning, 2008.

2. Worsnop & Flint, Advanced Practical Physics for Students (9e), Methuen & Co. Ltd, London 1987.

#### G. Lecture Plan:

Lec No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Discussion of Lecture Plan	To acquaint and clear teachers expectations and understand student expectations	Lecture	1030.1	NA
2	Experiments on interference	To make the student understand the difference between physical and geometrical optics. Recall elementary idea of transverse and longitudinal waves. Develop mathematical representation of waves.	Hands-on training	1030.1 & 1030.2	Continuous Assessment/Viva

3	Experiments on diffraction and dispersion	Understanding of the concept of coherent waves and interference	Hands-on training	<b>I030.2 &amp; I030.3</b>	Continuous Assessment/Viva
4	experiments on quantum theory of radiation	Derivation of the formula for intensity distribution in double slit interference	Hands-on training	<b>I030.2 &amp; I030.3</b>	Continuous Assessment/Viva
5	Experiments on band theory of solids	Understand the concept of thin-film interference	Hands-on training	<b>I030.3 &amp; I030.4</b>	Continuous Assessment/Viva
6	Experiments on semiconductors		Hands-on training	<b>I030.3, I030.4 &amp; I030.5</b>	Continuous Assessment/Viva
7	Experiments on resonance circuits	Understand the concept of interference in wedge shaped films and introduction to Newton's ring	Hands-on training	<b>I030.3, I030.4 &amp; I030.5</b>	Continuous Assessment/Viva
8	Experiments on Hall-effect		Hands-on training	<b>I030.3 &amp; I030.4</b>	Continuous Assessment/Viva

#### H. Course Articulation Matrix: (Mapping of COs with POs and PSOs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES															
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12				
PY I030.1	understand different type of error like backlash error, parallax etc. and its role in making conclusions.	3	3		1	2	1			3	1		1				
PY I030.2	gain knowledge on the behaviour of basic instruments like Slide Callipers, Vernier Callipers, screw gauge and spherometer etc.	3	2		2	2				1	2		1				
PY I030.3	acquire, analyse and process experimental data.	1	1	1			3	2		1	2	1	2				
PY I030.4	understand the facts and ideas in handling the practical applications of light, electricity sound and modern physics.				1	2			2	2	1		1				
PY	acquire hands on	1	3	1				3				2					

I030.5	skills on diverse experimental tools related to physics that are essential for engineering students																
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I- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation



# MANIPAL UNIVERSITY JAIPUR

School of Computing and Information Technology

Course Hand-out

## **Problem Solving Using Computers** | CS 1001 | 3 Credits | 3 0 0 3

Session: 2019-20 (odd Sem.) | Faculty: Dr. Punit Gupta, Mr Nitesh Pradhan, Dr Shivani Gupta, Ms. Neha Sharma, Dr Hemlata Goyal, Mr Harish Sharma, Ms. Shikha Mundra, Ms. Vinita Soni | Class: B.Tech 1<sup>st</sup> Year

- A. Introduction:** Programming in C focuses on basic computer fundamentals, number system and programming fundamentals. By means of C language students learn to write set of instruction to create a program so that desired output can be generated by computer.
- B. Course Outcomes:** At the end of the course, students will be able to
- [1001.1].** Demonstrate bitwise operations and conversion of numbers in different representations through Number System.
  - [1001.2].** Demonstrate a deep knowledge of computer for better understanding of devices, basic fundamental of computer comprises in this course.
  - [1001.3].** Design flow chart, Write algorithm and pseudo code parallel with Control Statements to understand flow of program execution.
  - [1001.4].** Create memory oriented operation using pointers and understating programming skills by Array, Structure, Union, Enum and String are added.
  - [1001.5].** Create program using concept of re-usability by means of functions in C.
  - [1001.6].** Illustrate the concept of data base by using file handling.
- C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES**
- [PO.1]. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
  - [PO.2]. Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
  - [PO.3]. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
  - [PO.4]. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
  - [PO.5]. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
  - [PO.6]. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal,

health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

**[PO.7]. Environment and sustainability:** Understand the impact of the professional engineering solutions in

societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

**[PO.8]. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the

engineering practices

**[PO.9]. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse

teams, and in multidisciplinary settings

**[PO.10]. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

**[PO.11]. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects

and in multidisciplinary environments

**[PO.12]. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

#### D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	20
	Sessional Exam II (Close Book)	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	20
End Term Exam (Summative)	End Term Exam (Close Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

#### E. SYLLABUS

Digital computer fundamentals: Algorithms and flowcharts, the von Neumann architecture, programs, assembly language, high level programming languages; Number System: binary, decimal, octal,

hexadecimal; Imperative programming (Using C): data types, variables, operators, expressions, statements, control structures, functions, arrays and pointers, recursion, records (structures), files, input/output, some standard library functions and some elementary data structures.

**F. Text Books**

T1. E. Balagurusamy, "Programming in ANSI C", 7th Edition, McGraw Hill Publication, 2016.

T2. Y. P. Kanetkar, "Let us C", 12th Edition, BPB Publication, 2014.

**G. Reference Books**

R1. B. W. Kernighan, D. M. Ritchie, "The C Programming Language", 2nd Edition, Prentice Hall of India, 2014.

R1. B. Gottfried, "Schaum's Outline Series: Programming with C", 3rd Edition, McGraw Hill Publication, 2012.

**H. Lecture Plan:**

lecture	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode Of Assessing CO
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1	Number systems: decimal, binary, octal, hexadecimal, base-r conversions	To acquaint knowledge about basics of number system	Lecture	1001.1	Mid Term I, Quiz & End Term
2	Number systems: decimal, binary, octal, hexadecimal, base-r conversions	To acquaint knowledge about basics of number system	Flipped Classroom	1001.1	Mid Term I, Quiz & End Term
3	Basic architecture of computers and its building block	Describing basic architecture of computer	Lecture	1001.2	Mid Term I, Quiz & End Term
4	Computer languages: machine language, assembly language, high level language; translators: assembler, compiler, interpreter	Differentiate between machine language and high level language	Lecture	1001.2	Mid Term I, Quiz & End Term
5	Short history, character set, tokens	Describing basics of datatype, token and keywords with differentiation between them.	Guided Self-Study	1001.3	Mid Term I, Quiz & End Term
6	Constants (integer, real, character, string); variables, keywords	Describe and implementation of various constant type	Lecture	1001.3	Mid Term I, Quiz & End Term
7	Data types ( table including range, memory and format specifier)	Implementation of various data type	Lecture	1001.3	Mid Term I, Quiz & End Term
8	Operators: arithmetic, relational, logical, assignment	Implementation of various arithmetic operations	Lecture	1001.3	Mid Term I, Quiz & End Term
9	Bitwise, conditional, type-cast, sizeof, comma	Implementation of various operators	Lecture	1001.3	Mid Term I, Quiz & End Term
10	Operator precedence and associativity, type conversion	Implementation of precedence in programming	Activity (Think Pair Share)	1001.3	Mid Term I, Quiz & End Term
11	Operator precedence and associativity, type conversion	Implementation of precedence in programming	Lecture	1001.3	Mid Term I, Quiz & End Term
12	Input and output statements (formatted and unformatted) : printf, scanf	Implementation of input and output statements	Lecture	1001.3	Mid Term I, Quiz & End Term
13	Gets, puts, getchar, putchar	Implementation of input and output statements using system functions	Activity (Jigsaw)	1001.3	Mid Term I, Quiz & End Term
14	Decision statements: if, if-else, nested if-else, if-else ladder	Implementation of decision statements	Lecture	1001.3	Mid Term I, Quiz & End Term
15	Decision statements: if, if-else, nested if-else, if-else ladder	Implementation of decision statements	Lecture	1001.3	Mid Term I, Quiz & End Term

16	Switch, break statement	Learning the implementation of switch and break	Flipped Class	1001.3	Mid Term I, Quiz & End Term
17	Switch, break statement	Learning the implementation of switch and break	Lecture	1001.3	Mid Term I, Quiz & End Term
18	Repetitive structures: for, while, do-while	Learning the implementation of looping	Lecture	1001.3	Mid Term II, Quiz & End Term
19	Repetitive structures: for, while, do-while	Learning the implementation of looping	Lecture	1001.3	Mid Term II, Quiz & End Term
20	Nested loops	Learning the implementation of looping	Activity (Think Pair Share)	1001.3	Mid Term II, Quiz & End Term
21	Nested loops	Learning the implementation of looping	Lecture	1001.3	Mid Term II, Quiz & End Term
22	Continue and break statements	Describe the usage of continue and break	Lecture	1001.3	Mid Term II, Quiz & End Term
23	Continue and break statements	Describe the usage of continue and break	Lecture	1001.3	Mid Term II, Quiz & End Term
24	1-D array: definition, declaration, initialization, input array, output array	Describe and define array of various data type	Lecture	1001.4	Mid Term II, Quiz & End Term
25	1-D array: definition, declaration, initialization, input array, output array	Describe and define array of various data type	Lecture	1001.4	Mid Term II, Quiz & End Term
26	1-D character array: character array, string, string standard function	Describe and define array of various data type	Lecture	1001.4	Mid Term II, Quiz & End Term
27	1-D character array: character array, string, string standard function	Describe and define array of various data type	Lecture	1001.4	Mid Term II, Quiz & End Term
28	1-D character array: character array, string, string standard function	Describe and define array of various data type	Lecture	1001.4	Mid Term II, Quiz & End Term
29	2-D array: definition, declaration, initialization, input array, output array, one simple program	Describe and define array of various data type	Lecture	1001.4	Mid Term II, Quiz & End Term
30	2-D array: definition, declaration, initialization, input array, output array, one simple program	Describe and define array of various data type	Lecture	1001.4	Mid Term II, Quiz & End Term
31	2-D array: definition, declaration, initialization, input array, output array, one simple program	Describe and define array of various data type	Lecture, Activity	1001.4	Mid Term II, Quiz & End Term

32	Pointers: introduction	Describe functionality of pointers in programming'	Lecture	1001.4	Mid Term II, Quiz & End Term
33	1-D Array and pointer	Implementation of 1D array with pointer	Lecture	1001.4	Mid Term II, Quiz & End Term
34	Functions: introduction to functions	Describe importance of function and modular programming	Lecture, Activity	1001.5	Mid Term II, Quiz & End Term
35	Function prototype, call, definition	Describe importance of function and modular programming	Lecture	1001.5	Mid Term II, Quiz & End Term
36	Storage classes	Describe usage of storage classes	Lecture	1001.5	Mid Term II, Quiz & End Term
37	Structures: definition, declaration, initialization, array of structures	Describe usage of structures	Lecture	1001.4	Quiz & End Term
38	Structures: definition, declaration, initialization, array of structures	Describe usage of structures	Lecture	1001.4	Quiz & End Term
39	Union, difference between union and structures	Describe usage of union	Lecture	1001.4	Quiz & End Term
40	File handling: introduction, operations on files, opening modes	Describe usage of file handling with various operations and modes	Lecture	1001.6	Quiz & End Term
41	File handling function	Describe usage of file handling with various operations and modes	Lecture	1001.6	Quiz & End Term
42	File handling function	Describe usage of file handling with various operations and modes	Lecture	1001.6	Quiz & End Term

**I. Course Articulation Matrix: (Mapping of COs with POs)**

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES											
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CS 1001.1:	Understand bitwise operations and conversion of numbers in different representations through Number System.	2											1
CS 1001.2:	Described a deep knowledge of computer for better understanding of devices, basic fundamental of computer comprises in this course.	2											
CS 1001.3:	Design flow chart, Write algorithm and pseudo code parallel with Control Statements to understand flow of program execution.	2		1									2
CS 1001.4:	Developing ability in students to learn memory oriented operation using pointers and understating programming skills by Array, Structure, Union, Enum and String are added.	3	1	3									2
CS 1001.5:	Students learnt the concept of reusability by means of functions in C.	3		3									3
CS 1001.6:	Illustrate the concept of data base by using file handling.	3											1

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**



# MANIPAL UNIVERSITY JAIPUR

School of Computing and Information Technology

Course Hand-out

## Problem Solving Using Computers Lab

| CS 1030 | 1 Credit | 0 0 1 1

Session: 2019-20 (odd Sem.) | Faculty: Dr. Punit Gupta, Mr Nitesh Pradhan, Dr Shivani Gupta, Ms. Neha Sharma, Dr Hemlata Goyal, Mr Harish Sharma, Ms. Shikha Mundra, Ms. Vinita Soni | Class: B.Tech 1<sup>st</sup> Year

- A. Introduction:** Problem Solving Using Computers focuses on basic computer fundamentals, number system and programming fundamentals. By means of C language students learn to write set of instruction to create a program so that desired output can be generated by computer.
- B. Course Outcomes:** At the end of the course, students will be able to
- [1030.1].** Demonstrate bitwise operations and conversion of numbers in different representations through Number System.
  - [1030.2].** Demonstrate a deep knowledge of computer for better understanding of devices, basic fundamental of computer comprises in this course.
  - [1030.3].** Design flow chart, Write algorithm and pseudo code parallel with Control Statements to understand flow of program execution.
  - [1030.4].** Create memory oriented operation using pointers and understating programming skills by Array, Structure, Union, Enum and String are added.
  - [1030.5].** Create program using concept of re-usability by means of functions in C.
  - [1030.6].** Illustrate the concept of data base by using file handling.
- C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES**
- [PO.1]. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- [PO.2]. Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
- [PO.3]. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
- [PO.4]. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
- [PO.5]. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
- [PO.6]. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering

practice

**[PO.7]. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

**[PO.8]. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices

**[PO.9]. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

**[PO.10]. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

**[PO.11]. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

**[PO.12]. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

#### D. Assessment Plan:

Criteria	Description	Maximum Marks
Lab	Practical Lab Exam	50
	Day to Day Assessment	50
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

#### E. SYLLABUS

Digital computer fundamentals: Algorithms and flowcharts, the von Neumann architecture, programs, assembly language, high level programming languages; Number System: binary, decimal, octal, hexadecimal; Imperative programming (Using C): data types, variables, operators, expressions, statements, control structures, functions, arrays and pointers, recursion, records (structures), files, input/output, some standard library functions and some elementary data structures.

#### F. Text Books

T1. E. Balagurusamy, "Programming in ANSI C", 7th Edition, McGraw Hill Publication, 2016.

T2. Y. P. Kanetkar, "Let us C", 12th Edition, BPB Publication, 2014.

#### G. Reference Books

R1. B. W. Kernighan, D. M. Ritchie, "The C Programming Language", 2nd Edition, Prentice Hall of India, 2014.

R1. B. Gottfried, "Schaum's Outline Series: Programming with C", 3rd Edition, McGraw Hill Publication, 2012.

**H. Lab Experiment Plan:**

<b>lecture</b>	<b>Topics</b>	<b>Session Outcome</b>	<b>Mode of Delivery</b>	<b>Corresponding CO</b>	<b>Mode Of Assessing CO</b>
1	Algorithms and Flow Charts	Describe the flowcharts and design of algorithm	Lecture	1030.1	Mid Term Lab Assessments and End Term Lab Assessment
2	Working with Linux Commands	Use Unix commands to manage files and develop programs, including multi-module programs	Lecture	1030.1	Mid Term Lab Assessments and End Term Lab Assessment
3	Formula based C Programs	Understand the fundamentals of C programming.	Lecture	1030.2	Mid Term Lab Assessments and End Term Lab Assessment
4	Control Structures: If statement	Choose the loops and decision making statements to solve the problem.	Lecture	1030.2	Mid Term Lab Assessments and End Term Lab Assessment
5	Control Structures: Switch	Choose the loops and decision making statements to solve the problem.	Lecture	1030.3	Mid Term Lab Assessments and End Term Lab Assessment
6	Control Structures: Loops	Choose the loops and decision making statements to solve the problem	Lecture	1030.3	Mid Term Lab Assessments and End Term Lab Assessment
7	Control Structures: Nested Loops	Choose the loops and decision making statements to solve the problem	Lecture	1030.3	Mid Term Lab Assessments and End Term Lab Assessment
8	1-D Array	Implement different Operations on arrays	Lecture	1030.3	Mid Term Lab Assessments and End Term Lab Assessment
9	2-D Arrays	Implement different Operations on arrays	Lecture	1030.4	Mid Term Lab Assessments and End Term Lab Assessment
10	Strings	Implementation of precedence in programing	Lecture	1030.4	Mid Term Lab Assessments and End Term Lab Assessment

11	Functions	Use functions to solve the given problem	Lecture	1030.5	Mid Term Lab Assessments and End Term Lab Assessment
12	Pointers	Understand pointers, structures and unions	Lecture	1030.5	Mid Term Lab Assessments and End Term Lab Assessment
13	Structures	Understand pointers, structures and unions	Activity (Jigsaw)	1030.6	Mid Term Lab Assessments and End Term Lab Assessment
14	End Term Exam				Mid Term Lab Assessments and End Term Lab Assessment

**I. Course Articulation Matrix: (Mapping of COs with POs)**

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES											
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CS 1030.1:	Demonstrate bitwise operations and conversion of numbers in different representations through Number System.	2											1
CS 1030.2:	Demonstrate a deep knowledge of computer for better understanding of devices, basic fundamental of computer comprises in this course.	2											
CS 1030.3:	Design flow chart, Write algorithm and pseudo code parallel with Control Statements to understand flow of program execution.	2		1									2
CS 1030.4:	Create memory oriented operation using pointers and understating programming skills by Array, Structure, Union, Enum and String are added.	3	1	3									2
CS 1030.5:	Create program using concept of re-usability by means of functions in C.	3		3									3
CS 1030.6:	Illustrate the concept of data base by using file handling.	3											1

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**



# MANIPAL UNIVERSITY JAIPUR

School of Civil and Chemical Engineering

Department of Civil Engineering

Course Hand-out

Basic Civil Engineering | CV1001 | 3 Credits | 3 0 0 3

Session: Jul 19 – Nov 19 | Faculty: Dr. Jitendra Singh Yadav | Class: B.Tech (First Year- Physics Group)

## A. Introduction:

This course is offered by Dept. of Civil Engineering as a departmental core course. The main objectives of this course are to understand, basics of civil engineering with are essential for everyone. The course covers principle of surveying, method and equipment's used for surveying, building material used for construction, different components of building, forces and its equilibrium, evaluation of centre of gravity and moment of inertia of simple and composite sections, simple stress and strain, method of analysis of truss, estimation and costing. Overall, this course will help to understand the basic of civil engineering used in our day to day life.

## B. Course Outcomes: At the end of the course, students will be able to

[CVI001.1]. Describe the importance and role of Civil Engineering and Civil Engineer in development of Society.

[CVI001.2]. Explain surveying and the type of instruments used for surveying.

[CVI001.3]. Describe the scientific terminologies related to building materials and components of building.

[CVI001.4]. Assess the force acting on a materials, centre of gravity and moment of inertia of composite area.

[CVI001.5]. Calculate the different type of stress like, simple stress, shear stress, and direct stress and strain in the material, and analysis of truss. Familiar to basic terminologies related to Estimation and Costing which create employability, and entrepreneurship.

## Program Outcomes and Program Specific Outcomes

[PO.1]. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

[PO.2]. **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

[PO.3]. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health

and safety, and the cultural, societal, and environmental considerations

[PO.4]. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

[PO.5]. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

[PO.6]. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal,

health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

**[PO.7]. Environment and sustainability:** Understand the impact of the professional engineering solutions

in

societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

**[PO.8]. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of

the

engineering practices

**[PO.9]. Individual and team work:** Function effectively as an individual, and as a member or leader in

diverse

teams, and in multidisciplinary settings

**[PO.10]. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

**[PO.11]. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects

and in multidisciplinary environments

**[PO.12]. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

### C. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	20
	Sessional Exam II (Closed Book)	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	20
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

### D. Syllabus

**Introduction:-** Scope of Civil Engineering, Role of Civil Engineer in Society, Impact of infrastructural development on economy of country; **Surveying:-** Principles and types of surveying, Site plans, Linear measurements, Angular measurements, Levelling, ordinary levels and total stations, Use of theodolite and plane table, contouring, L- section and cross sections;

**Buildings:-** Properties, uses of Stones, bricks, cement, timber, steel, plastics and paints. Properties of concrete. Selection of site for Buildings, Layout of building Plan, Types of buildings, Plinth Area, Carpet Area, Super built up area, floor space index, building bye laws, ventilation, components of buildings and their functions, Functional design of buildings, basic concepts of R.C.C., Type of foundations; **Mechanics of Solids:-** Forces and Equilibrium, Graphical and analytical treatment of concurrent and non-concurrent co-planer forces, Free body diagram, Frictional force in equilibrium problems; **Centroid and centre of gravity**, Moment of inertia of simple and composite areas; **Normal stress and strain**, Hooke's law, modulus of elasticity, modulus of rigidity, allowable stress, shear stress and shear strain; **Analysis of plane truss**, Method of joints, Method of sections; **Estimation and Costing:-** Types of estimates and Contracts, Tenders, NIT, EMD and Security deposits, Award of work, measurements, billing and payments.

#### **E. Text Books**

- T1.** Ramamrutham S., Basic Civil Engineering (3e), Dhanpat Rai Publishing Company (P) Ltd, 2013.
- T2.** Punamia B. C., Jain A. K., Jain A. K., Surveying Volume I (16e), S Chand, 2016.
- T3.** Dutta B. N., Estimation and Costing in Civil Engineering (28e), UBS Publishers Distributors LTD., 2016.
- T4.** Punamia B.C., Jain A. K., Jain A. K., Building Construction (11e), S Chand, 2016.
- T5.** Khurmi R. S., Strength of Material, S Chand, 2016
- T6.** Timoshenko S., Young D.H., Rao J.V., Pati S., Engineering Mechanics (5e), McGraw Hill, 2013.
- T7.** SP41 Handbook on Functional Design of Buildings, Bureau of Indian Standards 2013.

#### **Reference Books**

- R1.** Timoshenko S., Young D.H., Rao J.V., Pati S., Engineering Mechanics (5e), McGraw Hill, 2013.
- R2.** SP41 Handbook on Functional Design of Buildings, Bureau of Indian Standards 2013.

**F. Lecture Plan:**

Lec No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1,2	Introduction	Scope of Civil Engineering, Role of Civil Engineer in Society,	Lecture	1001.1	NA
3	Introduction	Impact of infrastructural development on economy of country	Lecture	1001.1	In Class Quiz
4,5	Surveying	Principles and types of surveying, Site plans, Linear measurements,	Lecture and field visit	1001.2	In Class Quiz End Term
6,7,8	Surveying	Angular measurements, Levelling, ordinary levels and total stations	Lecture and field visit	1001.2	Home Assignment End Term
9,10,11	Surveying	Use of theodolite and plane table, contouring, L- section and cross sections	Lecture and field visit	1001.2	In Class Quiz End Term
12	Building	Properties, uses of Stones, bricks, cement,	Lecture and field visit	1001.3	Class Quiz Mid Term I End Term
13	Building	Timber, steel, plastics and paints.	Lecture and field visit	1001.3	Class Quiz Mid Term I End term
14,15	Building	Properties of concrete.	Lecture	1001.3	Home Assignment Class Quiz Mid Term I End Term
16,17	Building	Selection of site for Buildings, Layout of building Plan, Types of buildings, Plinth Area, Carpet Area, Super built up area, floor space index, building bye laws, ventilation, components of buildings and their functions,	Lecture	1001.3	Class Quiz Mid Term I End Term
18,19	Building	Functional design of buildings, basic concepts of R.C.C., Type of foundations.	Lecture	1001.3	Class Quiz Mid Term I End Term
20	Mechanics of Solids	Forces and Equilibrium,	Lecture	1001.4	Class Quiz End Term
21	Mechanics of Solids	Graphical and analytical treatment of concurrent and non-concurrent	Lecture	1001.4	Class Quiz Mid Term II

		co-planer forces, Free body diagram			End Term
22	Mechanics of Solids	Frictional force in equilibrium problems	Lecture	1001.4	Class Quiz Mid Term II End Term
23,24,25	Mechanics of Solids	Numerical Exercises	Lecture	1001.4	Class Quiz Mid Term II End Term
26	Mechanics of Solids	Centroid and centre of gravity,	Lecture	1001.4	Class Quiz Mid Term II End Term
27	Mechanics of Solids	Moment of inertia of simple and composite areas.	Lecture	1001.4	Class Quiz End Term
28,29,20,31	Mechanics of Solids	Numerical Exercises	Lecture	1001.4	Class Quiz End Term
32	Mechanics of Solids	Normal stress and strain, Hooke's law	Lecture	1001.5	Class Quiz End Term
33	Mechanics of Solids	Modulus of elasticity, modulus of rigidity	Lecture	1001.5	Class Quiz End Term
34	Mechanics of Solids	Allowable stress, shear stress and shear strain	Lecture	1001.5	Class Quiz End Term
35, 36	Mechanics of Solids	Numerical Exercises	Lecture	1001.5	Class Quiz End term
37	Structure Analysis	Analysis of plane truss, Method of joints,	Lecture	1001.5	Class Quiz
38	Structure Analysis	Method of sections	Lecture	1001.5	Class Quiz Mid Term II End Term
39,40,41	Structure Analysis	Numerical Exercises	Lecture	1001.5	Class Quiz Mid Term II End Term
42	Estimation and Costing	Types of estimates and Contracts,	Lecture	1001.5	Class Quiz Mid Term II End Term
43	Estimation and Costing	Tenders, NIT, EMD and Security deposits,	Lecture	1001.5	Class Quiz End Term
44	Estimation and Costing	Award of work, measurements, billing and payments	Lecture	1001.5	Class Quiz End Term
45,46	Estimation and Costing	Numerical Exercises	Lecture	1001.5	Class Quiz End Term

**G. Course Articulation Matrix: (Mapping of COs with POs)**

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES											
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CV 1001.1	Importance and role of Civil Engineering and civil engineer in development of Society.			1			1	2			1		1
CV 1001.2	Get familiar with surveying and the type of instruments used for surveying.	2	1	2	3	3				3			
CV 1001.3	Describe the scientific terminologies related to building materials and components of building.	3	3	2		2	2	1		2			3
CV 1001.4	Assess the force acting on a materials, centre of gravity and moment of inertia of composite area.	3	3										
CV 1001.5	Calculate the different type of stress like, simple stress, shear stress, and direct stress and strain in the material, and analysis of truss. Familiar to basic terminologies related to Estimation and Costing which create employability, and entrepreneurship.	3	2	1							2	3	3

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**



# MANIPAL UNIVERSITY JAIPUR

Faculty of Engineering

Department of Chemistry

Course Hand-out

Engineering Chemistry | CY1001 | 3 Credits | 2 | 0 3

Session: Jul 19 – Nov 19 | Coordinator: Arunava Agarwala | Class: B.Tech. (I and II Sem)

**A. Introduction:** This course is offered by Dept. of Chemistry for all 1st year B.Tech. students. The objective of the course is to acquaint the students with the basic concepts of chemistry relevant to engineering field. The students with the knowledge of basic chemistry, will understand and explain scientifically the various chemistry related problems in the industry/engineering field.

**B. Course Objectives:** At the end of the course, students will be able to

- [1001.1]. Understand and apply concepts of various types of fuel technology
- [1001.2]. Develop skill of synthesis and applications of polymer and some advanced materials.
- [1001.3]. Explain different the water softening methods.
- [1001.4]. Understand and apply the concepts in electrochemistry and corrosion science in protecting metallic objects.
- [1001.5]. Apply the concept of phase rule to construct phase diagram
- [1001.6]. Develop skill in various modern analytical techniques.

## C. Program Outcomes and Program Specific Outcomes

- [PO.1]. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- [PO.2]. **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
- [PO.3]. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
- [PO.4]. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
- [PO.5]. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
- [PO.6]. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice
- [PO.7]. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
- [PO.8]. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices
- [PO.9]. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
- [PO.10]. **Communication:** Communicate effectively on complex engineering activities with the engineering

community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

**[PO.II]. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

**[PO.I2]. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

#### D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Mid Term Examination I	20
	Mid Term Examination II	20
	Quiz tests (Accumulated and Averaged)	20
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work at home/ hostel especially before a quiz test or MTE-I/MTE-II. A student is expected to participate and perform these assignments with full zeal since the activity.	

#### E. Syllabus

**Unit-I** Classification of Fuels, Gross Calorific value and Net Calorific value. Solid, Liquid and Gaseous fuels.

**Unit-II:** Advanced materials and polymers: Liquid crystals, ceramics, composites, bio-materials, nanomaterials, thin films and their properties and applications.

**Unit-III:** Water treatment technology.

**Unit- IV:** Concept of corrosion and its importance, types of corrosion, factors affecting corrosion, Corrosion control methods. Chemistry of primary and secondary batteries. Working principles of fuels cells and their applications.

**Unit-V:** Theory and application phase rule (up to two component system).

**Unit VI;** General methods of chemical analysis, Instrumental methods. Introduction to spectroscopic methods of analysis: Electromagnetic radiation (EMR), Interaction of EMR with matter, Numerical Problems. Concepts of rotational, vibrational and electronic spectra, Laws of spectrophotometry

#### F. Text Books

T1. Jain P.C. and Jain M., Engineering Chemistry, Dhanpat Rai and Sons, Delhi, Revised, 15th Edn. 2006.

T2. Kuriacose J.C., Raja R. J., Chemistry in Engineering and Technology, Vol. I/II TMH 1988

#### G. Reference Books

*No reference books required for this course.*

## H. Lecture Plan:

Lec No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1.	<b>Chemical fuels:</b> Introduction, Classification, Calorific value. Gross calorific value and net Calorific value. Determination of calorific value by Bomb calorimeter.	To acquaint and clear teachers expectations and understand student expectations	Lecture	1001.1	Class Quiz End Term
2.	Determination of calorific value by Boys; Numerical problems based on Bomb and Boys calorimeter.	Working of the calorimeter	Lecture, Activity	1001.1	Class Quiz Mid Term I
3.	Dulong formula; Numerical problems.	Analyse and solve numerical problems	Lecture, Activity	1001.1	Class Quiz End Term
4.	Solid fuels – Coal and its analysis – Proximate and Ultimate analysis.	Analyse and solve numerical problems	L Lecture, Activity	1001.1	Home Assignment End Term
5.	Liquid Fuels: Fractional Distillation, Petroleum cracking - catalytic cracking (Fixed Bed and moving bed) and Reforming of petroleum, Synthetic Petrol: Burgius process, Fisher Tropsch method. Composition and applications of water gas, Producer gas.	Principles of distillation, cracking	Lecture	1001.1	Class Quiz End Term
6.	Numerical based on Combustion ( By Weight Type and By Volume Type )	Analyse and solve numerical problems	Lecture, Activity	1001.2	Class Quiz Mid Term I End Term
7.	<b>Advanced materials and polymers:</b> Introduction, Definition, classification of polymers – based on origin, thermal behaviour, Polymerization reactions and applications, Tacticity. Functionality, Degree of polymerization, Co-polymerization – alternating, random, block and graft polymers	Describe the working of polymer	Lecture	1001.2	Class Quiz Mid Term I End term
8.	Mechanism of free radical polymerization and ionic polymerization. Mechanism of coordination polymerization, Condensation polymerization reactions, Glass transition temperature & factors affecting it	Describe mechanization of polymerization	Lecture	1001.2	Class Quiz Mid Term I End Term
9.	Molecular weight of polymers, Number average and weight average molecular weights, Numerical problems.	Analyse and solve numerical problems	Lecture, Activity	1001.2	Class Quiz Mid Term I End Term
10.	Preparation, properties and applications of Polythene (LDPE and HDPE), Nylon( 6:6, 6,	Identify alternative ways to synthesize rubbers.	Lecture	1001.2	Class Quiz Mid Term I

	6:10, 11), PF resins and Polyester. Natural rubber, Processing of Natural Rubber; Vulcanization, Compounding of rubber; Synthetic Rubber: Buna-N, Buna-S				End Term
11.	Liquid crystals: their properties and applications	Gain knowledge of liquid crystals	Lecture	1001.2	Class Quiz End Term
12.	Ceramics: Properties and applications	Gain knowledge of ceramics	Lecture	1001.2	Class Quiz Mid Term I End Term
13.	Composites and bio-materials: properties and applications	Gain knowledge of bio-materials	Lecture	1001.2	Class Quiz Mid Term I End Term
14.	Nanomaterials and thin films: Properties and applications	Understand basics of nanochemistry	Lecture	1001.2	Class Quiz Mid Term I End Term
15.	Revision	Recall and recap the lessons learnt during last 14 lectures	Lecture, Activity		Class Quiz Mid Term I End Term
16.	<b>Water Technology:</b> Introduction, Characteristics imparted by impurities in water, Hardness of water Degree of hardness.	Describe the properties of water and its application	Lecture	1001.3	Class Quiz Mid Term II End Term
17.	Determination of hardness by EDTA method. Numerical problems.	Describe working hardness/softness of water	Lecture, Activity	1001.3	Class Quiz Mid Term II End Term
18.	Softening of hard water: Internal treatment by phosphate and calgon condition. Softening of hard water: External treatment by lime soda process.	Describe working hardness/softness of water	Lecture	1001.3	Class Quiz Mid Term II End Term
19.	Softening of hard water: Ion exchange method; Zeolite methods	Describe working hardness/softness of water	Lecture.	1001.3	Class Quiz Mid Term II End Term
20.	Softening of hard water, internal treatment by phosphate, calgon condition and colloid conditioning	Describe working hardness/softness of water	Lecture	1001.3	Class Quiz Mid Term II End Term
21.	Numerical problems based on lime soda process.	Analyse and solve numerical problems	Lecture, Activity	1001.3	Class Quiz Mid Term II End Term
22.	<b>Corrosion and its Control:</b> Introduction, significance, types of corrosion, dry corrosion. Nature of oxide layers; PB Rule	Describe corrosion and its preventions	Lecture, Activity	1001.4	Class Quiz Mid Term II End Term
23.	Wet Corrosion: Electrochemical corrosion	Describe corrosion and its preventions	Lecture	1001.4	Class Quiz Mid Term II End Term

24.	Galvanic corrosion; Differential aeration corrosion: Pitting corrosion, Water line corrosion, Crevice corrosion.	Describe corrosion and its preventions	Lecture	1001.4	Class Quiz Mid Term II End Term
25.	Factors affecting corrosion: Nature of the metal, Nature of the Environment	Describe corrosion and its preventions	Lecture	1001.4	Class Quiz Mid Term II End Term
26.	Corrosion prevention by material selection and design alternation of environment by changing medium; Stress corrosion – Caustic embrittlement	Describe corrosion and its preventions	Lecture	1001.4	Class Quiz Mid Term II End Term
27.	Cathodic protection –sacrificial anode and impressed voltage methods, Anodic protection; Inhibitors – Anodic and Cathodic inhibitors, Protective coating – Metal coating (Electroplating, galvanization, Tinning).	Describe corrosion and its preventions	Lecture	1001.4	Class Quiz Mid Term II End Term
28.	Introduction and theory of batteries and fuel cells.	Gain knowledge of batteries	Lecture	1001.4	Class Quiz Mid Term II End Term
29.	Chemistry (working) of primary and secondary batteries.	Gain knowledge of batteries	Lecture	1001.4	Class Quiz Mid Term II End Term
30.	Working principles of fuels cells and their applications.	Gain knowledge of fuel cells	Lecture	1001.4	Class Quiz Mid Term II End Term
31.	<b>Revision</b>	Recall and recap the lessons learnt during last 14 lectures	Lecture, Activity		Class Quiz Mid Term II End Term
32	<b>The Phase Rule:</b> Definition, Phase rule equation, Phase, Component; Degree of freedom, examples to solve number of phase, component and degree of freedom	Gain knowledge of phase rule	Lecture	1001.5	Class Quiz End Term
33	One component system: Water system; Sulphur system	Gain knowledge of phase rule	Lecture	1001.5	Class Quiz End Term
34	Lead Silver system; Pattinson's process, Limitations of phase rule	Gain knowledge of phase rule	Lecture	1001.5	Class Quiz End Term
35	<b>General methods of chemical analysis, Instrumental methods:</b> Introduction, pH metric analysis, Conductrometric analysis. Chromatographic techniques.	Gain skill in various modern analytical techniques.	Lecture	1001.6	Class Quiz End Term
36	Paper chromatography ( $R_f$ value); Thin layer chromatography; Gas Chromatography;	Gain skill in various chromatographic techniques.	Lecture	1001.6	Class Quiz End Term
37	Introduction to spectroscopic analysis. Beer-	Gain skill in various modern	Lecture, Activity	1001.6	Class Quiz

	Lambert's law; Numerical problems.	analytical techniques.			End Term
38	Principle of UV visible spectroscopy.	Gain skill in analytical techniques using Uv-Vis spectroscopy.	Lecture	1001.6	Class Quiz End Term
39	Instrumentation of UV visible spectroscopy	Gain skill in analytical techniques using Uv-Vis spectroscopy.	Lecture	1001.6	Class Quiz End Term
40	Principle of IR (vibrational) spectroscopy.	Gain skill in analytical techniques using IR spectroscopy.	Lecture	1001.6	Class Quiz End Term
41	Instrumentation of IR spectroscopy	Gain skill in analytical techniques using IR spectroscopy.	Lecture	1001.6	Class Quiz End Term
42	Revision	Recall and recap the lessons learnt during the semester	Lecture, Activity		Class Quiz End Term

### I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES											
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CY 1001.1	Understand and apply concepts of various types of fuel technology.	2						3			2		2
CY 1001.2	Understand the synthesis and applications of polymer and some advanced materials			2					2				3
CY 1001.3	Develop understanding about the water softening methods.	2				3					3		2
CY 1001.4	Understand and apply the concepts in electrochemistry and corrosion science in protecting metallic objects.								2				2
CY 1001.5	Develop concept of phase rule		2			2			2				3
CY 1001.6	Understand various modern analytical techniques.	2				3			2				3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation



# MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Chemistry

Course Hand-out

Environmental Studies | CY 1002 | 3 Credits | 3 0 0 3

Session: Jul 19 – Nov 19 | Co-ordinator: Dr. M. Prabhu Inbaraj | Class: B. Tech (I Semester)

**A. Introduction:** This course is offered to B. Tech. first year students for understanding the different aspects of our environment and issues related to it. The course aims at exposure to various environmental issues (regional, national and international), relevant sources of information about different issues including environmental systems and functions, environmental problems and solutions, role of public and Govt., etc. The course aims at generating useful ideas, concepts for meaningful field work in the immediate environment and self-study of books, journals, and magazines on the subject. The course introduces multi-disciplinary approach to the study of various environmental issues. The approach will facilitate participatory learning about importance of conservation, preservation and protection of the environment and striving towards a life in perfect harmony with nature.

**B. Course Outcomes:** At the end of the course, students will be able to;

- [1002.1].** Develop fundamental skills in understanding the environment, ecology and ecosystem for sustainable development saving the environment.
- [1002.2].** Apprehend environmental problems and its linkage to health and safety of society; think and act with a sense of responsibility, committing to the professional ethics.
- [1002.3].** Impart knowledge on the application of the techniques / procedures to predict / qualitatively assess the reduction in the environmental impact for sustainable development.
- [1002.4].** Promote the active involvement of oneself and society in designing the activities / processes with which the environment and ecosystem would be preserved, considering public health and safety.
- [1002.5].** Explore the impacts of various man-made activities from an environmental context. Students can demonstrate the knowledge by participating in class debates and presentations on various topics of environmental concern with effective communication.

## **C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES**

- [PO.1]. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- [PO.2]. Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
- [PO.3]. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
- [PO.4]. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

- [PO.5]. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
- [PO.6]. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice
- [PO.7]. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
- [PO.8]. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices
- [PO.9]. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
- [PO.10]. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
- [PO.11]. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments
- [PO.12]. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

**D. Assessment Plan:**

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	20
	Sessional Exam II (Closed Book)	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	20
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

## E. SYLLABUS

**Environmental Studies** – Meaning, multidisciplinary nature of environmental science, applications in engineering disciplines, environmental ethics, sustainable development. **Ecology** – Types and Structure of Ecosystem. **Biodiversity** – Importance, classification, conservation methods. **Natural Resources** – Renewable and non-renewable, Resource consumption, different types of energy, Conventional sources & Non-Conventional sources of energy. **Environmental Engineering** – Environmental Pollution and control: Air / Water / Soil / Noise pollution, Water demand, Water quality standards, basics of water treatment, Conservation of water, Characteristics of sewage, treatment and disposal, Solid waste management. **Disaster Management** – meaning, natural disasters especially earthquakes & Manmade disasters. **Environmental crisis & legislations** – Global environmental problems, Environmental acts, Laws and Policies, EIA, Case studies of the past related to environmental issues, Practical activity related to environmental problems and its impacts on environment.

## F. TEXT BOOKS

- T1. Rajagopalan, R., Environmental Studies; From Crisis to Cure 3<sup>rd</sup> Edition, Oxford University Press, 2016.
- T2. De, A. K. and De, A. K., Environmental Studies 2<sup>nd</sup> Edition, New Age International Publishers, New Delhi, 2009.
- T3. Bharucha, E., Text book of Environmental Studies for undergraduate courses 4<sup>th</sup> Edition, Universities Press, Hyderabad, 2013.

## G. REFERENCE BOOKS

- R1. Tyler Miller, Jr. and Scott E. Spoolman., Environmental Science 13<sup>th</sup> Edition, Brooks/Cole, Cengage Learning, Belmont, CA, USA, 2010.
- R2. Daniel B. Botkin and Edward A. Keller., Environmental Science - Earth as a Living Planet 8<sup>th</sup> Edition, John Wiley & Sons, INC. 2011.

**Lecture Plan:**

Lec No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	<b>Multidisciplinary Nature of Environmental Studies:</b> Scope of environmental studies, a multidisciplinary view, Importance of environmental studies	Explain the uniqueness / importance of Environmental Studies as an interdisciplinary subject	Lecture	<b>1002.1</b>	Mid Term I End Term
2	<b>Components of the Earth:</b> Spheres of the earth: Atmosphere, Lithosphere, Hydrosphere, Biosphere	Recall the importance and role played by each spheres in Earth	Lecture	<b>1002.1</b>	Mid Term I End Term
3	<b>Environmental Ethics:</b> systematic and critical study of practices, holistic approach	Describe the role of ethics in having concern for other creatures other than human beings, preservation and conservation of all species	Lecture	<b>1002.1</b>	Mid Term I End Term
4	<b>Ecology:</b> Structure / function / components of the ecosystem	In-depth knowledge on the importance of basics in ecology	Lecture	<b>1002.1</b>	Mid Term I End Term
5	<b>Ecosystem:</b> Classification, Energy transfer, Ecological pyramids	Explain ecosystem with structure, flow of energy, food chain and food webs	Lecture	<b>1002.1</b>	Mid Term I End Term
6	<b>Bio-geochemical cycles:</b> Hydrological, Oxygen, Nitrogen	Explain chemical elements cycle through different ecosystems	Lecture	<b>1002.1</b>	Mid Term I End Term
7	<b>Bio-geochemical cycles:</b> Carbon, Sulphur, Phosphorous	Explain chemical elements cycle through different ecosystems	Lecture	<b>1002.1</b>	Mid Term I End Term
8	<b>Ecological succession:</b> Primary & Secondary	Explain the power of nature to reclaim itself without the intervention of humans	Lecture	<b>1002.1</b>	Mid Term I End Term
9	<b>Biodiversity:</b> Importance and classification	Explain services provided by biodiversity, different type of biodiversity and Biogeographic zones of India	Lecture	<b>1002.2</b>	Mid Term I End Term
10	<b>Threats to biodiversity:</b> Species extinction, Threatened, Invasive species	Explain biodiversity loss, biological invasive species and their impact on biodiversity	Lecture	<b>1002.2</b>	Mid Term I End Term
11	<b>Conservation of biodiversity:</b> IUCN, Hotspots, CBD	Explain different measures to conserve biodiversity, description of National parks, wildlife sanctuaries etc.	Lecture	<b>1002.2</b>	In Class Quiz Mid Term I End Term
12	<b>Revision for MTE I</b>	Revision for preparation for mid-term exam	Lecture	NA	NA
13	<b>Energy Resources:</b> Conventional and non-conventional	Recall different energy resources including coal, oil, nuclear and their environmental impacts on the environment and on human health	Lecture	<b>1002.3</b>	Mid Term II End Term
14	<b>Water Resources</b>	Explain importance of sources of water, stress on water consumption and it's conservation	Lecture	<b>1002.3</b>	Mid Term II End Term
15	<b>Forest Resources</b>	Explain importance of forest resources, it's ecological role, deforestation and conservation	Lecture	<b>1002.3</b>	Mid Term II End Term
16	<b>Land and Mineral Resources</b>	Explain kinds of mining, it's impact and remediation	Lecture	<b>1002.3</b>	Mid Term II End Term

17	<b>Energy Resources:</b> Conservation and Management	Explain the importance of conserving the different energy resources	Lecture	<b>1002.3</b>	Mid Term II End Term
18	<b>Environmental pollution:</b> Air pollution – sources and classification of air pollutants	Recall air pollution, explain different air pollutants and their impacts on environment and human health	Lecture	<b>1002.3</b>	Mid Term II End Term
19	<b>Air pollution control:</b> Source control, equipment control, diffusion	Describe control methods of air pollutants like ESP, Scrubber	Lecture	<b>1002.3</b>	Mid Term II End Term
20	<b>Water pollution:</b> Sources of water pollution, classification of water pollutants	Describe water pollutants types and classifications	Lecture	<b>1002.3</b>	Mid Term II End Term
21	<b>Water pollution:</b> Effects of water pollution, Water quality parameters	Explain the negative impact of water pollution on humans and environment	Lecture	<b>1002.3</b>	Mid Term II End Term
22	<b>Wastewater treatment process:</b> Primary, Secondary and Tertiary	Detailed knowledge on various types / stages involved in wastewater treatment	Lecture	<b>1002.3</b>	In Class Quiz Mid Term II End Term
23	<b>Soil pollution:</b> Sources, effects and control of soil pollution	Explain the Causes, effects and control of soil Pollution	Lecture	<b>1002.3</b>	Mid Term II End Term
24	<b>Noise pollution:</b> sources, effects and control of noise pollution	Explain the Causes, effects and control of noise Pollution	Lecture	<b>1002.3</b>	Mid Term II End Term
25	<b>Municipal Solid-Waste Management:</b> sources, characteristics and control measures	Explain the Causes, effects and control of solid waste	Lecture	<b>1002.3</b>	Mid Term II End Term
26	<b>Hazardous-Waste Management:</b> Land Disposal and Integrated Waste Management (3Rs)	Explain the safe disposal of hazardous wastes	Lecture	<b>1002.3</b>	Mid Term II End Term
27	<b>Revision for MTE II</b>	Revision for preparation for mid-term exam	Lecture		Mid Term II End Term
28	<b>Disaster Management:</b> Natural disasters	Describe natural disasters and their impact	Lecture	<b>1002.4</b>	End Term
29	<b>Disaster Management:</b> Manmade disasters	Explain measures of man-made disaster management	Lecture	<b>1002.4</b>	End Term
30	<b>Global warming / Climate change:</b> Causes, effects and control measures	Describe global warming, climate change with its effects and control	Lecture	<b>1002.4</b>	End Term
31	<b>Acid rain:</b> Causes, effects and control measures	Describe the Acid Rain with its effects and control	Lecture	<b>1002.4</b>	End Term
32	<b>Ozone depletion:</b> Causes, effects and control measures	Explain the importance of ozone layer and causes of its depletion, control measures	Lecture	<b>1002.4</b>	End Term
33	<b>Environmental Laws/Acts:</b> Air, Water, Forest & Wildlife	Describe the provision of Water Act, 1974, Air Act, 1981 for prevention and control of water and air pollution, Explain EPA, 1986	Lecture	<b>1002.4</b>	End Term
34	<b>Environmental Movements:</b> Chipko, Narmada dam, Silent valley, etc.,	Describe different movement in India for conserving environment and their socio-economic importance	Lecture	<b>1002.4</b>	End Term
35	<b>International Environmental Policies:</b> CBD, Montreal, Kyoto	Role of international policies towards curbing the global environmental issues	Lecture	<b>1002.4</b>	End Term
36	<b>Environment and Human health</b>	Explain the inter-relationship between humans and environment	Lecture	<b>1002.4</b>	End Term
37	<b>Environmental impact assessment (EIA):</b>	Explain the stages involved in EIA and it's importance	Lecture	<b>1002.4</b>	In Class Quiz

	Methodology and importance	before initiating a project			End Term
38	<b>Human Population and the Environment:</b> Population growth, variation among nations, Population explosion – Family Welfare Program	Explain how population expansion is directly correlated to environmental degradation	Lecture	<b>1002.5</b>	End Term
39	<b>Case studies of Environmental issues</b>	Analyse case studies from different perspective and finding solutions	Lecture	<b>1002.5</b>	End Term
40	Practical activity related to environmental problems	In-class practical activity / discussion on environmental issues	Practical	<b>1002.5</b>	End Term
41	Practical activity related to environmental problems	In-class practical activity / discussion on environmental issues	Practical	<b>1002.5</b>	End Term
42	<b>Revision for ETE</b>	Revision for preparation for end term exam	Lecture	NA	NA
43	<b>Revision for ETE</b>	Revision for preparation for end term exam	Lecture	NA	NA

## H. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES											
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
[1002.1].	Apply the fundamental knowledge of environment, ecology and ecosystem to save the environment for sustainable development.	3		1			1	2					3
[1002.2].	Apprehend environmental problems and its linkage to the health and safety of society; think and act with a sense of responsibility, committing to the professional ethics.		3				3		3	2			
[1002.3].	Know the application of the technique / procedures to predict / qualitatively assess the reduction in the environmental impact for sustainable development.	3	1			3	2	3		1			3
[1002.4].	Realise the active involvement of oneself and society in designing the activities / processes with which the environment and ecosystem would be preserved, considering public health and safety.			1	1					3			
[1002.5].	Explore the impacts of various man-made activities from an environmental context. Students can demonstrate the knowledge by participating in class debates and presentations on various topics of environmental concern with effective communication.	2			2		3					1	3

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**



# MANIPAL UNIVERSITY JAIPUR

Faculty of Engineering

Department of Chemistry

Course Hand-out

Engineering Chemistry Laboratory| CY1030 | I Credit | 0 0 2 I

Session: Jul 19 – Nov 19 | Coordinator: Arunava Agarwala | Class: B.Tech. (I and II Sem)

**A. Introduction:** This course is offered by Dept. of Chemistry for all 1st year B.Tech. students. The objective of the course is to acquaint the students with the basic methods applied in chemical science laboratory relevant to engineering field.

**B. Course Objectives:** At the end of the course, students will be able to

[1030.1]. Develop skill in quantitative chemical analysis.

[1030.2]. Apply concept of synthetic chemistry.

[1030.3]. Analyse physical property of materials.

**C. Program Outcomes and Program Specific Outcomes**

[PO.1]. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

[PO.2]. **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

[PO.3]. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

[PO.4]. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

[PO.5]. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

[PO.6]. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

[PO.7]. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

[PO.8]. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices

[PO.9]. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

[PO.10]. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

[PO.11]. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

[PO.12]. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in

**D. Assessment Plan:**

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Class wise assessment (Viva; Practical performance)	60
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Homework/ Home Assignment/ Activity Assignment (Formative)	A student is expected to participate and perform all the experiments with full zeal.	

**E. Syllabus**

Alkalimetric titration; Redox titration; Estimation of total hardness of water; pK value of an acid by pH-metric titration; Conductometric acid base titrations; pH Metric acid base titrations; Synthesis of a resin; Determination of coefficient of viscosity of liquid; Determination cloud and pour point of a given sample of lubricating oil using cloud and pour point apparatus; Determine the water equivalent of bomb calorimeter using benzoic acid as fuel.

**F. Text Books**

T1. Jain P.C. and Jain M., Engineering Chemistry, Dhanpat Rai and Sons, Delhi, Revised, 15th Edn. 2006.

T2. Kuriacose J.C., Raja R. J., Chemistry in Engineering and Technology, Vol. I/II TMH 1988

**G. Reference Books**

*No Reference books required for this course.*

## H. Lecture Plan:

Lec No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1.	Determination of strength of given unknown ferrous ammonium sulphate solution by titrating against standard $K_2Cr_2O_7$ using diphenylamine as an internal indicator	Develop skill in quantitative chemical analysis.	Activity	I030.1	Practical Assessments and End Term Lab Assessment
2.	Determination of strength of given unknown ferrous ammonium sulphate solution by titrating against standard $K_2Cr_2O_7$ using potassium ferricyanide as an external indicator.	Develop skill in quantitative chemical analysis.	Activity	I030.1	Practical Assessments and End Term Lab Assessment
3.	Determination of the total, permanent and temporary hardness of given water sample by complexometric titration using EDTA solution	Develop skill in quantitative chemical analysis.	Activity	I030.1	Practical Assessments and End Term Lab Assessment
4.	Determination of the strength of sodium carbonate and sodium hydroxide in given alkali mix. (water sample) hydrochloric acid is used as an intermediate solution, methyl orange and phenolphthalein used as indicators	Develop skill in quantitative chemical analysis.	Activity	I030.1	Practical Assessments and End Term Lab Assessment
5.	Determination of the strength of ferrous Ammonium Sulphate by titrating against $KMnO_4$ solution	Develop skill in quantitative chemical analysis.	Activity	I030.1	Practical Assessments and End Term Lab Assessment
6.	Preparation of urea formaldehyde resin	Apply concept of synthetic chemistry.	Activity	I030.2	Practical Assessments and End Term Lab Assessment
7.	Determination of strength of given HCl solution using a standard NaOH solution by performing a pH-metric titration.	Analyse physical property of materials	Activity	I030.1	Practical Assessments and End Term Lab Assessment
8.	Determination of strength of given HCl solution using a standard NaOH solution by performing a conductometric titration.	Analyse physical property of materials	Activity	I030.1	Practical Assessments and End Term Lab Assessment
9.	Determination of strength of given $CH_3COOH$ solution using a standard NaOH solution by performing a pH-metric titration.	Analyse physical property of materials	Activity	I030.1	Practical Assessments and End Term Lab Assessment
10.	Determination of $pK_{a1}$ and $pK_{a2}$ of phosphoric acid.	Analyse physical property of materials	Activity	I001.3	Practical Assessments and End Term Lab Assessment
11.	Titration of a mixture of strong acid HCl and weak acid $CH_3COOH$ and determine the Determination of unknown strength of HCl and	Analyse physical property of materials	Activity	I001.3	Practical Assessments and End Term Lab Assessment

	CH <sub>3</sub> COOH pH-metrically				
12.	the equivalent conductance of given an electrolyte	Analyse physical property of materials	Activity	I001.3	Practical Assessments and End Term Lab Assessment
13.	Determination of the viscosity of a given lubricating oil at various temperatures using Redwood Viscometer No. 1 or No. 2. / Determination of cloud and pour point of a given sample of lubricating oil using cloud and pour point apparatus	Analyse physical property of materials	Activity	I001.3	Practical Assessments and End Term Lab Assessment
14.	Demonstration of working of bomb calorimeter.	Analyse physical property of materials	Activity	I001.3	Practical Assessments and End Term Lab Assessment

**I. Course Articulation Matrix: (Mapping of COs with POs)**

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES											
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CY 1030.1	Develop skill in quantitative chemical analysis.	2						3			2		2
CY 1030.2	Apply concept of synthetic chemistry.			2					2				3
CY 1030.3	Analyse physical property of materials.	2				3					3		2

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

# MANIPAL UNIVERSITY JAIPUR

School of Electrical Electronics & Communication Engineering

Department of Electronics & Communication Engineering

Course Hand-out

Basic Electronics| EC 1001 | 3 Credits | 2 1 0 3

Session: July 19 – Nov 19 | Faculty: Vishal Das | Class: Core Subject

## A. Introduction:

The growth of mobile telephony, broadband and wireless internet has led to the growth of career opportunities in the field of communication engineering. This course is a basic overview of electronic components and their common uses. It covers the characteristics and applications of analog and digital circuit components. Emphasis is placed on analysis, selection and applications. The coverage is not as deep as an electronics course aimed at electrical engineers. There are a number of physical applications demonstrated in this course that serve to motivate a wider audience. The course is ideal for someone who wants to gain a basic understanding of electrical circuits, hobbyists, or for someone who is considering electrical engineering as a career.

Review of physics, introduction to semiconductor devices: diodes and transistors. Equivalent circuits and models of semiconductor devices. DC biasing circuits for transistors. Analysis and design of transistor amplifiers. Operational amplifier systems. Number System, Boolean Algebra, Specification and implementation of combinational and sequential systems. Introduction to basic electronic communication systems.

**B. Course Outcomes:** At the end of the course, students will be able to:

**[EC1001.1].** Apply principles of physics to describe and analyse the working of semiconductor devices and integrated circuits and hence develop employability skills.

**[EC1001.2].** Analyse different biasing configurations of Bipolar Junction Transistor

**[EC1001.3].** Analyse Inverting or Non-Inverting amplifier structures comprising of Operational Amplifier and to promote development of skills towards core employability

**[EC1001.4].** Demonstrate inter-conversion on different number systems

**[EC1001.5].** Demonstrate minimization of Boolean expressions

**[EC1001.6].** Identify different elements of communication

## C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

**[PO.1]. Engineering knowledge:** Demonstrate and apply knowledge of Mathematics, Science, and Engineering to classical and recent problems of electronic design & communication system.

**[PO.2]. Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**[PO.3]. Design/development of solutions:** Design a component, system, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

**[PO.4]. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

**[PO.5]. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

- [PO.6]. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice
- [PO.7]. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
- [PO.8]. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices
- [PO.9]. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
- [PO.10]. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
- [PO.11]. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments
- [PO.12]. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

#### D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I	20
	Sessional Exam II	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	20
End Term Exam (Summative)	End Term Exam	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

## E. SYLLABUS

PN Junction: Formation of depletion region, Effect of forward and reverse bias on depletion region, I-V characteristics and equivalent circuits of ideal and practical diode, Diode equation. Application of Diode: Series and parallel combination of diodes circuits, Half Wave and Full Wave rectifiers, capacitor filter, clipper, clamper circuits, Zener Diode; I-V Characteristics, Zener Regulators. BJT: Construction, schematic diagram and characteristic of CE, CB Configuration, CC configuration w.r.t. CE, Relation between  $\alpha$  and  $\beta$ , transistor biasing, Q-point, load line, fixed bias, self-bias. Operational Amplifier: Ideal characteristics of an Op. Amp., Inverting and Non-inverting, amplifiers, Linear Circuit applications as voltage follower, integrator, differentiator, summing amplifier, subtractor. Digital Electronics: Number systems, Boolean algebra, De Morgan's Theorem, logic gates; Truth tables, SOP, POS form, K-map for minimization of Boolean expressions, Implementation of Boolean expressions with logic gates, Introduction to combinational & sequential circuits. Communication Systems: Elements of communication systems, Analog modulation scheme.

## TEXT BOOKS

1. R. L. Boylestad, L. Nashelsky, Electronic Devices and Circuit Theory, (10e), Pearson, 2009.
2. S. Salivahanan, S. Arivazhagan, Digital circuits and Design, (5e), Oxford University Press, 2018.
3. G. Kennedy, B. Davis, S R M Prasanna, Electronic Communication systems, (6e), Mcgraw Hill, 2017.
4. V. K. Mehta, Rohit Mehta, Principles of Electronics, (10e), S. Chand Publication, 2006.
5. B. L. Thereja, Basic Electronics: Solid state, (5e), S. Chand Publication, 2005.

## H. Lecture Plan:

LEC NO.	TOPICS	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Overview of Semiconductors	Recall concept of Semiconductors		EC1001.1 (CO 1)	NA
2	Introduction to Extrinsic Semiconductors	Understanding of Doping	Lecture	EC1001.1 (CO 1)	In Class Quiz
3	Introduction to PN junction diode, Formation of depletion region	Understanding of switches	Lecture	EC1001.1 (CO 1)	In Class Quiz
4	Forward and reverse bias, I-V Characteristics	Understanding of switch operation and their characteristics	Lecture	EC1001.1 (CO 1)	In Class Quiz Mid Term I
5, 6	Equivalent circuits of ideal and practical diode	Model of the diode for circuits	Lecture	EC1001.1 (CO 1)	In Class Quiz
7	Diode equation	Introduction to the drift and diffusion in diode equation.	Lecture	EC1001.1 (CO 1)	In Class Quiz Mid Term I End Term
8-10	Application to Diodes: Series and Parallel combination of diode circuits	Use of switches to get different function in electrical circuits	Lecture	EC1001.1 (CO 1)	In Class Quiz Mid Term I End Term
11	Half and Full wave rectifiers	Introduction to pulsating D.C	Lecture	EC1001.1 (CO 1)	In Class Quiz Mid Term I End Term
12	Capacitor Filter	Introduction to Filters	Lecture	EC1001.1 (CO 1)	
13-14	Clipper circuits	Understanding of wave shaping circuits	Lecture	EC1001.1 (CO 1)	In Class Quiz Mid Term I End Term
15	Clamper circuits	Understanding of wave	Lecture	EC1001.1 (CO 1)	In Class Quiz

		shaping circuits			Mid Term I End Term
16	Zener diode and its I-V characteristics	Understanding of voltage regulating device.	Lecture	ECI001.1 (CO 1)	In Class Quiz
17-18	Zener regulators	Understanding of voltage regulating circuits	Lecture	ECI001.1 (CO 1)	In Class Quiz Mid Term I End Term
19	Tutorial				
20	Introduction to BJT	Understanding of three terminal devices	Lecture	ECI001.2 (CO 2)	In Class Quiz
21	Operation of BJT	Understanding of minority carrier movement	Lecture	ECI001.2 (CO 2)	In Class Quiz
22	Transistor configuration: symbolic representation and CB Characteristics.	Characteristics of BJT under various config.	Lecture	ECI001.2 (CO 2)	In Class Quiz Mid Term II End Term
23	Transistor configuration: symbolic representation and CE Characteristics	Characteristics of BJT under various config.	Lecture	ECI001.2 (CO 2)	In Class Quiz Mid Term II End Term
24	CC configuration w.r.t. CE, Relation between $\alpha$ and $\beta$	Characteristics of BJT under various config.	Lecture	ECI001.2 (CO 2)	In Class Quiz Mid Term II End Term
25	Transistor Biasing, Q-point, Load line	Effect of load on the characteristics	Lecture	ECI001.2 (CO 2)	In Class Quiz Mid Term II End Term
26	Fixed biasing	Effect of load on the characteristics	Lecture	ECI001.2 (CO 2)	In Class Quiz Mid Term II End Term
27	Self-biasing	Effect of load on the characteristics	Lecture	ECI001.2 (CO 2)	In Class Quiz Mid Term II End Term
28	Introduction to Operational Amplifier, Op. Amp Characteristics.	Understanding the OPAMP characteristics and its difference from BJT as an amplifier.	Lecture	ECI001.3 (CO 3)	In Class Quiz
29	Inverting amplifier	Application of OPAMP	Lecture	ECI001.3 (CO 3)	In Class Quiz Mid Term II End Term
30	NON-Inverting amplifier, Linear applications of Op. Amp as voltage follower	Application of OPAMP	Lecture	ECI001.3 (CO 3)	In Class Quiz Mid Term II End Term
31	Summing amplifier, Subtractor	Application of OPAMP	Lecture	ECI001.3 (CO 3)	In Class Quiz Mid Term II End Term
32	Integrator, Differentiator	Application of OPAMP	Lecture	ECI001.3 (CO 3)	In Class Quiz Mid Term II End Term
33	Tutorial				

34	Digital Electronics: Number system	Mathematical understanding of Number System	Lecture	ECI001.4 (CO 4)	In Class Quiz
35	Boolean algebra, DeMorgan's theorem	Understanding the Algebra in Digital Electronics	Lecture	ECI001.5 (CO 5)	In Class Quiz End Term
36	Logic gates, Truth table.	Basic entities of Digital Electronics	Lecture	ECI001.5 (CO 5)	In Class Quiz End Term
37	Implementation of Boolean expression with logic gates	Use of Logic Gates to implement any Logic in Digital	Lecture	ECI001.5 (CO 5)	In Class Quiz End Term
38	SOP, POS forms	Understanding of various forms to represent a Logic	Lecture	ECI001.5 (CO 5)	In Class Quiz End Term
39	K-Map for minimization of Boolean expressions	A systematic way to minimize the given logic	Lecture	ECI001.5 (CO 5)	In Class Quiz End Term
40	S-R Flip Flop	Understanding of Basic Sequential Circuits	Lecture	ECI001.5 (CO 5)	In Class Quiz End Term
41	Introduction to communication system & Analog Modulation Scheme	Basic concept of Communication	Lecture	ECI001.6 (CO 6)	In Class Quiz End Term
42	Tutorial				

# I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES											
		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	PO 10	PO 11	PO 12
[EC1101.]	Apply principles of physics to describe and analyse the working of semiconductor devices and integrated circuits	3	2	3	1			1					1
[EC1101.]	Analyse different biasing configurations of bipolar junction transistor	3	2	1	2	1							1
[EC1101.]	Analyse inverting or non-inverting amplifier structures comprising of operational amplifiers	3	3	3	2	2							1
[EC1101.]	Demonstrate interconversion on different number systems	3	2	3	2	2		1					1
[EC1101.]	Demonstrate minimization of Boolean expressions	3	3	1	2	2							1
[EC1101.]	Identify different elements of communication	3	2	2	2		1						2



**MANIPAL UNIVERSITY JAIPUR**  
School of Electrical, Electronics and Communication

Department of Electrical Engineering  
Course Hand-out

Basic Electrical Technology | EE 1101 | 4 Credits | 2 1 0 3

Session: July. 19 – Nov. 19 | Faculty: Dr. Manish Kumar Thukral | Class: First Year (All Branches)

**A. Introduction:** This course is offered by Dept. of Electrical Engineering as a basic fundamental subject to impart essential knowledge and information of Electrical Technology and their applications. The learning objective would cover the following aspects: -

- To develop circuit designing skills through general insight of circuit laws and theorems.
- To analyse the magnetic & electric circuit and calculate different parameters
- To develop and analyse the single and three phase circuits.
- To understand the concepts of basic construction & operation of transformer.
- To understand the fundamentals of DC & Induction motors and measuring Instruments.

**B. Course Outcomes:** At the end of the course, students will be able to

- [1101.1]. Recall basic circuit laws and apply theorems to analyse different types of DC circuits.
- [1101.2]. Understand and apply the basic concepts of electromagnetism.
- [1101.3]. Identify and evaluate different configurations of single phase & three phase ac circuits.
- [1101.4]. Understand and apply the construction and operating principle of transformer.
- [1101.5]. Illustrate the basic operating principles of DC machines & Induction motors and fundamental measuring Instruments

**C. Program Outcomes and Program Specific Outcomes**

**[PO.1].Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

**[PO.2].Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

**[PO.3].Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

**[PO.4].Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

**[PO.5].Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

**[PO.6].The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

**[PO.7].Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

**[PO.8].Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices

**[PO.9].Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

**[PO.10]. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

**[PO.11]. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

**[PO.12]. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

#### D. Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	20
	Sessional Exam II (Closed Book)	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	20
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

## **E. Syllabus**

DC circuits, Independent sources, Resistance, Network reduction techniques, Mesh and Node voltage analysis, Superposition, Thevenin's and Maximum power transfer theorems, Transient behaviour of inductance and capacitance, Self and Mutual inductances, Coupled coils, Dot rule, Average and RMS values of sinusoidal waves, Series and Parallel AC circuits, Phasor Analysis, Power factor improvement, Series and Parallel resonance, Three phase star and delta connected loads, Measurement of power in three phase circuits, Electrical power system, Emf Equation, Construction & Types of Transformers, DC motors, BLDC, Induction motors, Synchronous motors, Stepper motors, Fundamentals of Electrical Measuring Instruments.

## **F. TEXT BOOKS**

1. Nagasarkar & Sukhija, Basic Electrical Engineering, Oxford University Press, 2006.
2. S.K. Sahdev, Fundamentals of Electrical Engineering & Electronics, Dhanpat Rai & Co, 2010.
3. D. C. Kulshreshtha, Basic Electrical Engineering, McGraw Hill Education India, 2011.

## **G. REFERENCE BOOKS**

1. S. N. Singh, Basic Electrical Engineering, PHI, 2011.
2. D. P. Kothari. & I. J. Nagarath, Basic Electrical Technology, TMH 2004.

## H. Lecture Plan:

Lec No	Topics	Session Outcomes	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
L1	Introduction to the Course	To acquaint students with the outcome based education (OBE) and Course outcome (CO) and program outcome (PO) assessment process	Lecture		NA
L2	Basic circuit elements, Source Transformation	Recall the basic elements of a DC network	Lecture	[1101.1]	Class Quiz
L3	Series & parallel resistive circuits, Review of Kirchhoff's laws	Identify different series and parallel network configurations and their equivalent resistance calculation	Lecture	[1101.1]	Home Assignment Class Quiz
L4-L5	Star-Delta transformation	Explain the need of star-delta transformation and their applications	Lecture	[1101.1]	Home Assignment Class Quiz
T1	L1 – L5	Numerical problems based on L1-L5	Tutorial	[1101.1]	Mid Term Exam
L6 – L7	DC Circuit Analysis – Mesh & Node analysis methods	Recall KVL and KCL and apply them to find solution of different dc network problems using Mesh & Node analysis methods	Lecture	[1101.1]	Mid Term Exam
T2-T3	L6 – L7	Numerical problems based on L6-L7	Tutorial	[1101.1]	Mid Term Exam
L8-L11	DC Network Theorems: Superposition, Thevenin, Norton, Maximum Power Transfer	Analyze and solve different dc network problems using all mentioned theorems	Lecture	[1101.1]	Home Assignment Class Quiz Mid Term Exam
T4-T5	L8-L11	Numerical problems based on L8-L11	Tutorial	[1101.1]	Mid Term Exam
L12	Capacitor, Series & Parallel connections, Charging & Discharging, Energy stored	Recall series and parallel connection of capacitors and energy stored	Lecture	[1101.2]	Class Quiz
L13	Inductor, Series & parallel connections, Growth & Decay of current in inductive circuit, Energy Stored	Recall series and parallel connection of inductors and energy stored	Lecture	[1101.2]	Class Quiz
T6	L12 – L13	Numerical problems based on L12-L13	Tutorial	[1101.2]	Class Quiz
L14– L15	Magnetic circuits, Terminologies, Analysis of series and parallel circuits	Recall the concept of magnetic circuits and their configurations	Lecture	[1101.2]	Class Quiz
L16	Review of Electromagnetism, Electromagnetic Induction, Fleming's left & right hand rules, Lenz's Law	Recall the Fleming's rule, Lenz's law, Faraday's law and review the concept of Electromagnetism	Lecture	[1101.2]	Class Quiz
L17– L18	Induced emf in a conductor & coil, Mutual Inductance, Coupling Coefficient and dot rule	Describe the concept of emf induced in coil, dot rule and Coupling Coefficient	Lecture	[1101.2]	Class Quiz
T7-T8	L14– L18	Numerical problems based on L14-L18	Tutorial		Class Quiz
L19-L20	Single phase circuits: Generation, Emf induced, Average value, RMS value, Peak factor, Form factor	Describe the concept of generation of ac voltage and waveform analysis	Lecture	[1101.3]	Class Quiz
L21 – L24	Phasors, Analysis of pure R, L, C, Series RL, RC and RLC circuits, Impedance, Power, Power	Describe the phasor operations and calculation of different quantities pertaining	Lecture	[1101.3]	Mid Term Exam

	factor	to different combinations of series ac circuits			
L25-L26	Analysis of Parallel RL, RC and RLC circuits	Analyze and calculate different quantities pertaining to parallel ac circuits	Lecture	[1101.3]	Mid Term Exam
T9-T10	L19 – L26	Numerical problems based on L19-L26	Tutorial	[1101.3]	Mid Term Exam
L27 – L28	Series & Parallel Resonance, Resonant frequency, Voltage & Current magnification	Recall and examine the series and parallel resonance phenomenon	Lecture	[1101.3]	Class Quiz
T11	L27– L28	Numerical problems based on L27-L28	Tutorial	[1101.3]	Class Quiz
L29-L30	Three phase ac circuits, Advantages, Types of connections, Voltage & Currents, Line & Phase values	Identify and analyse different types of Three phase ac circuits	Lecture	[1101.3]	Class Quiz
L31-L32	Analysis of balanced 3 wire & 4 wire star and delta connected systems, Phasor diagrams	Analyze three phase balanced star and delta connected systems	Lecture	[1101.3]	Mid Term Exam
L33	Measurement of three phase power by two wattmeter method	Examine two wattmeter method for three phase power Measurement	Lecture	[1101.3]	Mid Term Exam
T12-T13	L29 – L33	Numerical problems based on L29-L33	Tutorial	[1101.3]	Class Quiz
L34	Single phase transformer: Introduction, types, Construction, Operating principle, Emf equation	Recall and analyse operating principle of Single phase transformer and their types	Lecture	[1101.4]	Class Quiz
L35 – L36	Ideal & practical transformer, Losses and Efficiency, Voltage regulation	Compare the ideal and practical transformer and analyse different performance parameters	Lecture	[1101.4]	Mid Term Exam
T14	L34 – L36	Numerical problems based on L34-L36	Tutorial	[1101.4]	Class Quiz
L37 - L38	Introduction of single and three phase induction motors	Describe the operating principle of single and three phase induction motors	Lecture	[1101.5]	Class Quiz
L39-L40	DC Machine: Introduction, Construction, Types	Describe the construction and operating principle of DC machine	Lecture	[1101.5]	Class Quiz
L41-L42	Fundamentals of Electrical Measuring Instruments	Describe the construction and operating principle of different Measuring Instruments	Lecture	[1101.5]	Class Quiz

**I. Course Articulation Matrix: (Mapping of COs with POs)**

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES											
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
EE 1101.1	Develop circuit designing skills through general insight of circuit laws and theorems.	3	2										2
EE 1101.2	Understand the basic concepts of electromagnetism	2	1										2
EE 1101.3	Identify and evaluate different configurations of single phase & three phase ac circuits.	1	2										3
EE 1101.4	Understand the construction and operating principle of transformer and evaluate efficiency.	2	2	1			1	1					2
EE 1101.5	Illustrate the basic operating principles of DC & Induction motors and fundamental measuring Instruments.						1	1					

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

# MANIPAL UNIVERSITY JAIPUR

School of Humanities and Social Sciences

## DEPARTMENT OF LANGUAGES

Course Hand-out



Communication Skills in English | LN 1001 | 2 Credits | 2 0 0 2

Session: July 19-Nov 19 | Faculty: Dr Arun Kumar Poonia | Class: B-Tech I Semester

- A. Introduction:** This course is offered by the Department of Languages as a common course to the students of B. Tech in Semester-I/II. The course offers an in-depth knowledge of language as an important branch of English language studies. It covers basic concepts such as role of communication, vocabulary, comprehension, composition, and presentation skills. It also focuses on the enhancement of critical thinking, reasoning abilities, active listening, proper and appropriate writing skills in various practical situations.
- B. Course Outcomes:** At the end of the course, students will be able to
- [LN1001.1]** Apply the fundamental principles of effective communication in day to day life as well as in the professional world.
  - [LN1001.2]** Develop critical and creative thinking abilities for communicative competence
  - [LN1001.3]** Organize and express ideas clearly in speech
  - [LN1001.4]** Develop ideas with precision and coherence in writing
  - [LN1001.5]** Utilize analytical communicative skills for effective presentations during employment opportunities and later on working in a team.
- C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES**
- [PO.1]. Engineering knowledge:** Demonstrate and apply knowledge of Mathematics, Science, and Engineering to classical and recent problems of electronic design & communication system.
  - [PO.2]. Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
  - [PO.3]. Design/development of solutions:** Design a component, system, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
  - [PO.4]. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
  - [PO.5]. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
  - [PO.6]. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

- [PO.7]. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- [PO.8]. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.
- [PO.9]. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- [PO.10]. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- [PO.11]. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- [PO.12]. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

**D. Assessment Plan:**

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	20
	Sessional Exam II (Closed Book)	20
	CWS (In class Assignments & 3 Quizzes- Best2 Assignments & Quizzes will be counted)	10+10=20
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who miss a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work at home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom	

## E. SYLLABUS

**Communication:** Definition, process, features, types, modes, and barriers; **LSRW Skills- Listening:** Listening to groups and individuals- active listening, response, and feedback; comprehending conversations and lectures; **Reading:** Analysis of passages; skimming and scanning; contextual meaning; advanced vocabulary; **Writing:** Paragraph writing; Writing Creative and Critical responses; Formal letters; Emails; Résumés; Statement of Purpose; **Speaking:** Presentation, Discussion, and Debate on current affairs, scientific enquiry, philosophical attributions, literary sensibilities, socio-political awareness, and cultural sensitivity; Telephonic Etiquettes; Role Play; Team Work; Time Management; Grooming; Exploring multiple perspectives- critical reasoning, constructive feedback, persuasive arguments, and effective interpersonal communication.

## F. REFERENCES:

- 1) Meenakshi Raman and S. Sharma, Technical Communication: Principles and Practice, (2/e), Oxford University Press, 2013.
- 2) N. Krishnaswamy, Modern English: A Book of Grammar Usage and Composition, Macmillan India, 2018.
- 3) Sanjay Kumar and Pushplata, Communication Skills, Oxford University Press, 2016.
- 4) Sunita Mishra and C. Muralikrishna, Communication Skills for Engineers, Pearson, 2014.

## G. Lecture Plan:

DAY	TOPICS	Programme objective	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
Day 1	Introduction about the course hand-out/ Examination scheme/Internal Assessment and Communication skills.	Review communication as a process with greater awareness	Lecture, PPT, Discussion	1001.1	Quizzes, I Sessional, End Term Examination
Day 2 & 3	Definition, process, features, types, modes, and barriers	Display enhanced competence in oral communication	Lecture, PPT, Discussion	1001.1, 1001.2	Quizzes, I Sessional, End Term Examination
Day 4 & 5	LSRW Skills- Listening: Listening to groups and individuals- active listening, response, and feedback	Display enhanced competence in oral and written communication	Lecture, PPT, Discussion	1001.1, 1001.2	Quizzes, I Sessional, End Term Examination

Day 6	Comprehending conversations and lectures	Use appropriate communication skills in specific contexts and for specific purposes	Lecture, PPT, Discussion	1001.1, 1001.2	Quizzes, I Sessional, End Term Examination
Day 7 & 8	<b>Reading:</b> Analysis of passages; skimming and scanning; contextual meaning	Use appropriate communication skills in specific contexts and for specific purposes	Lecture, PPT, Discussion	1001.1, 1001.2	Quizzes, II Sessional, End Term Examination
Day 9	Advanced vocabulary	Demonstrate meaningful group communication exchanges	Lecture, PPT, Discussion	1001.2, 1001.3, 1001.4	Quizzes, II Sessional, End Term Examination
Day 10	<b>Writing:</b> Paragraph writing; Writing Creative and Critical responses	Develop critical and creative thinking abilities for communicative competence	Lecture, PPT, Discussion	1001.1, 1001.2, 1001.4	Quizzes, II Sessional, End Term Examination
Day 11 & 12	Formal letters; Emails	Develop critical and creative thinking abilities for communicative competence	Lecture, PPT, Discussion	1001.1, 1001.2, 1001.4	Quizzes, II Sessional, End Term Examination
Day 13 & 14	Resume and Statement of Purpose	Develop critical and creative thinking abilities for communicative competence	Lecture, PPT, Discussion	1001.1, 1001.2, 1001.4	Quizzes, II Sessional, End Term Examination

Day 15	<b>Speaking:</b> Presentation Skills and discussion.	Use appropriate communication skills in specific contexts and for specific purposes	Lecture, PPT, Discussion	1001.1, 1001.2, 1001.3, 1001.5	Quizzes, End Term Examination
Day 16-18	Debate on current affairs, scientific enquiry, philosophical attributions, literary sensibilities, socio-political awareness, and cultural sensitivity	Use appropriate communication skills in specific contexts and for specific purposes	Lecture, Discussion and any case study	1001.1, 1001.2, 1001.3	Quizzes
Day 19	Telephonic Etiquettes	Use appropriate communication skills in specific contexts and for specific purposes	Lecture, PPT, Discussion	1001.1, 1001.3	Quizzes, End Term Examination
Day 20 & 21	Role Play and Team Work	Use appropriate communication skills in specific contexts and for specific purposes	Lecture, PPT, Discussion	1001.1, 1001.5	Quizzes
Day 22 & 23	Time Management and grooming	Develop critical and creative thinking abilities	Lecture and Discussion	1001.1, 1001.3, 1001.5	Quizzes
Day 24-26	Exploring multiple perspectives- critical reasoning, constructive feedback, persuasive arguments	Develop critical and creative thinking abilities	Lecture, PPT, Discussion, any case study	1001.1, 1001.2, 1001.3	Quizzes
Day 27 & 28	Effective interpersonal communication	Use appropriate communication skills in specific contexts and for specific purposes	Lecture, PPT, Discussion, any case study	1001.1, 1001.3, 1001.5	Quizzes

#### H. Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	STATEMENT	Correlation with Program Outcomes (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
[LN1001.1]	Apply the fundamental principles of effective communication in day to day life as well as in the professional world						1		2	1	1		
[LN1001.2]	Develop critical and creative thinking abilities for communicative competence		1				1		1				
[LN1001.3]	Organize and express ideas clearly in speech									1	1		
[LN1001.4]	Develop ideas with precision and coherence in writing		1								1		
[LN1001.5]	Utilize analytical communicative skills for effective presentations and team work						1		1	2	2	1	

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation



# MANIPAL UNIVERSITY JAIPUR

School of Engineering

Department of Mathematics & Statistics

Course Hand-out

Engineering Mathematics-I | MA 1101 | 4 Credits | 3 | 0 4

Session: July 19 – Nov 19 | **Dr Sunil Joshi** | Class: Ist Year

**A. Introduction:** An engineering student needs to have some basic mathematical tools and techniques which emphasize the development of rigorous logical thinking and analytical skills. Based on this, the course aims at giving adequate exposure to the theory and applications. The course is aimed at developing the basic Mathematical skills of engineering students that are imperative for effective understanding of engineering

**B. Course Outcomes:** At the end of the course, students will be able to

**[MA1101.1]** To describe the concept of ODE and their applications to solve the problems

**[MA1101.2]** To describe the concept of Interpolation, Numerical differentiation & integration and their applications and in real life problems.

**[MA1101.3]** To Describe the concept of numerical methods to evaluate the roots of Algebraic & Transcendental equations and solutions of ODE though which one could develop programming skills to develop the skill of solving the complex problems which intern become employable in corporate sector

**[MA1101.4]** To Describe the concept of rank for the matrix by solution of the system of linear equations and developed their skill to solve engineering application based problems.

**[MA1101.5]** To Describe the basic concepts of vector space and to analysis the problems having engineering applications.

## C. Program Outcomes and Program Specific Outcomes

**[PO.1]. Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

**[PO.2]. Problem Analysis:** Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

**[PO.3]. Design/ Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.

**[PO.4]. Conduct investigations** of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.

**[PO.5]. Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

- [PO.6]. **The Engineer and Society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.
- [PO.7]. **Environment and Sustainability:** Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
- [PO.8]. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
- [PO.9]. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.
- [PO.10]. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.
- [PO.11]. **Project Management and Finance:** Demonstrate knowledge and understanding of engineering and management principles and apply these to owners own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- [PO.12]. **Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

#### D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	20
	Sessional Exam II (Closed Book)	20
	Quizzes (Open Book/Closed Book) and Assignments	20
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Homework/ Home Assignment/ (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. A student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

#### E. Syllabus

Matrices-inverse and rank, solution of linear system of equations, Eigen value problems. Vector spaces, basis, linear transformations, inner product spaces and Orthogonalization. First and higher order differential equations and their solutions; finite difference and interpolation for equal and unequal intervals, Numerical differentiation and integration. Solution of algebraic and transcendental equations, solutions of ordinary differential equations.

#### F. Text Book:

- I. Grewal B. S., *Higher Engineering Mathematics*, (42e), Khanna Publishers, 2013

#### G. Reference Book:

1. Kreyszig E., *Advanced Engineering Mathematics*, (10e), Wiley Eastern, 2011
2. Lay David C., *Linear Algebra and applications*, (3e), Pearson Education, 2009
3. Sastry S. S., *Introductory methods of Numerical analysis*, (4e), PHI, 2007

4. Iyengar S.R.K. and Jain, Rajendra K., *Advance Engineering Mathematics (3e)*, Narosa book distributors Pvt Ltd-New Delhi, 2007
5. Ramana B. V., *Higher Engineering Mathematics (6th reprint)*, Tata Mcgraw-Hill, New Delhi, 2008

#### H. Lecture Plan:

Lecture N o.	Description of the Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction: Basic definitions, solving first order differential equations using Variable separable method.	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.1	Quizzes, assignments, Two Sessional, End Term Examination
2	Homogeneous	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.1	Quizzes, assignments, Two Sessional, End Term Examination
3	reducible to Homogeneous	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.1	Quizzes, assignments, Two Sessional, End Term Examination
4	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	1101.1	Quizzes, assignments, Two Sessional, End Term Examination
5	Linear D. E	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.1	Quizzes, assignments, Two Sessional, End Term Examination
6	Bernouli equations	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.1	Quizzes, assignments, Two Sessional, End Term Examination
7	Solution of Exact differential equations	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.1	Quizzes, assignments, Two Sessional, End Term Examination
8	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	1101.1	Quizzes, assignments, Two Sessional, End Term Examination

9	Reducible to exact methods	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.1	Quizzes, assignments, Two Sessional, End Term Examination
10	higher order differential equations - finding CF	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.1	Quizzes, assignments, Two Sessional, End Term Examination
11	Inverse differential operator method to calculate P.I for $e^{ax}$ , $\sin(ax+b)$ and $\cos(ax+b)$	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.1	Quizzes, assignments, Two Sessional, End Term Examination
12	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	1101.1	Quizzes, assignments, Two Sessional, End Term Examination
13	Inverse differential operator method to calculate P.I for $x^m$ , $e^{ax} v$	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.1	Quizzes, assignments, Two Sessional, End Term Examination
14	P.I using method of variation of parameters	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.1	Quizzes, assignments, Two Sessional, End Term Examination
15	Finite difference operators and relation among them.	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.2	Quizzes, assignments, Two Sessional, End Term Examination
16	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	1101.2	Quizzes, assignments, Two Sessional, End Term Examination
17	Newton-Gregory forward and backward interpolations	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.2	Quizzes, assignments, Two Sessional, End Term Examination
18	Stirlings formula	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.2	Quizzes, assignments, Two Sessional, End Term Examination

19	Lagrange's and inverse interpolation for unequal intervals.	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.2	Quizzes, assignments, Two Sessional, End Term Examination
20	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	1101.2	Quizzes, assignments, Two Sessional, End Term Examination
21	Numerical Differentiation - forward and backward formulas	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.2	Quizzes, assignments, Two Sessional, End Term Examination
22	Numerical Differentiation - Central formula	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.2	Quizzes, assignments, Two Sessional, End Term Examination
23	Numerical differentiation for unequal intervals	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.2	Quizzes, assignments, Two Sessional, End Term Examination
24	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	1101.2	Quizzes, assignments, Two Sessional, End Term Examination
25	Numerical Integration- Newton Cotes formula	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.2	Quizzes, assignments, Two Sessional, End Term Examination
26	Trapezoidal and Simpson's 1/3 rd rules of integration	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.2	Quizzes, assignments, Two Sessional, End Term Examination
27	Simpson's 3/8 th rule of integration, Weddle rule	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.2	Quizzes, assignments, Two Sessional, End Term Examination
28	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	1101.2	Quizzes, assignments, Two Sessional, End Term Examination

29	Solution of algebraic and transcendental equations : Bisection method	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	I I 01.3	Quizzes, assignments, Two Sessional, End Term Examination
30	Regula –Falsi method	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	I I 01.3	Quizzes, assignments, Two Sessional, End Term Examination
31	Solution by Newton Raphson's method	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	I I 01.3	Quizzes, assignments, Two Sessional, End Term Examination
32	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	I I 01.3	Quizzes, assignments, Two Sessional, End Term Examination
33	Numerical solution of ordinary differential equations- by Taylor series method	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	I I 01.3	Quizzes, assignments, Two Sessional, End Term Examination
34	Numerical solution of ordinary differential equations- by Euler 's method and modified Euler's method	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	I I 01.3	Quizzes, assignments, Two Sessional, End Term Examination
35	Runge-Kutta method order 4	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	I I 01.3	Quizzes, assignments, Two Sessional, End Term Examination
36	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	I I 01.3	Quizzes, assignments, Two Sessional, End Term Examination
37	Matrices and their properties, Elementary row transformations and Echelon matrix	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	I I 01.4	Quizzes, assignments, Two Sessional, End Term Examination
38	Rank of the matrix with problems	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	I I 01.4	Quizzes, assignments, Two Sessional, End Term Examination

39	Consistency of the system of homogeneous/non homogeneous equations: Solution by Gauss elimination	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.4	Quizzes, assignments, Two Sessional, End Term Examination
40	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	1101.4	Quizzes, assignments, Two Sessional, End Term Examination
41	Gauss Jordan method for inverse evaluation, examples	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.4	Quizzes, assignments, Two Sessional, End Term Examination
42	Iterative method for solving system of equations: Gauss Jacobi method	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.4	Quizzes, assignments, Two Sessional, End Term Examination
43	Gauss Seidel method	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.4	Quizzes, assignments, Two Sessional, End Term Examination
44	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	1101.4	Quizzes, assignments, Two Sessional, End Term Examination
45	Eigen values , eigen vectors and their properties	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.4	Quizzes, assignments, Two Sessional, End Term Examination
46	Linear combination of vectors, Linear span, some theorems on Linear span	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.5	Quizzes, assignments, Two Sessional, End Term Examination
47	Linear dependency and independency of vectors with problems	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.5	Quizzes, assignments, Two Sessional, End Term Examination
48	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	1101.5	Quizzes, assignments, Two Sessional, End Term Examination

49	Definition of Basis, Spanning set with problems	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.5	Quizzes, assignments, Two Sessional, End Term Examination
50	Inner product space	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.5	Quizzes, assignments, Two Sessional, End Term Examination
51	Orthogonal basis and orthonormal basis. Gram Schmidt orthogonalization to construct Orthonormal basis	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.5	Quizzes, assignments, Two Sessional, End Term Examination
52	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	1101.5	Quizzes, assignments, Two Sessional, End Term Examination

#### I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES											
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
MA1101.1	To describe the concept of ODE and their applications to solve the problems	3	3	1	3	1				2		2	1
MA1101.2	To describe the concept of Interpolation, Numerical differentiation & integration and their applications and in real life problems.	3	2	2	2	2				2		1	1
MA1101.3	To Describe the concept of numerical methods to evaluate the roots of Algebraic & Transcendental equations and solutions of ODE though which one could develop programming skills to develop the skill of solving the complex problems which intern become	3	2	2	2	2				3		3	1

	employable in corporate sector												
MA1101.4	To Describe the concept of rank for the matrix by solution of the system of linear equations and developed the their skill to solve engineering application based problems.	3	3	2	3	2				1		2	1
MA1101.5	To Describe the basic concepts of vector space and to analysis the problems having engineering applications.	2	2	1	2	3				2		2	1





# MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Mechanical Engineering

Course Hand-out

BASIC MECHANICAL ENGINEERING| ME 1001 | 3 Credits | 3 0 0 3

Session: July 19 – Nov. 19 | Faculty: Hemant Raj Singh | Class: I Year

**A. Introduction:** Basic Mechanical Engineering is a brief overview of mechanical engineering that makes the students familiar with the basic concepts of Mechanical Engineering. It provides a systematic introduction to the basic elements of mechanical systems while emphasizing the underlying working principles important in understanding the functioning of mechanical systems and processes which involves energy carrier (working fluid i.e. steam), energy and its transformation, steam generator, refrigeration and air-conditioning, power producing and consuming devices, power transmission devices and manufacturing processes.

**B. Course Outcomes:** At the end of the course, students will be able to

**[ME1001.1]** Understand the fundamental concepts to the basic elements of mechanical systems while emphasizing the underlying working principles important in understanding the functioning of mechanical systems and processes.

**[ME1001.2]** Apply laws of thermodynamics on engineering processes.

**[ME1001.3]** Design and analyse the concepts of components, (I.C. Engine, Steam Generator, Refrigerator, Steam Turbine, Machine Tools, Power Transmitting devices and Manufacturing Processes etc.).

**[ME1001.4]** Analyse the concepts of manufacturing in the context of mechanical applications.

**[ME1001.5]** Apply the concept of thermodynamics and manufacturing processes to design/utilize the power generating, power consuming and manufacturing devices thus increasing the employability in industries.

**C. Program Outcomes and Program Specific Outcomes**

**[PO.1]. Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

**[PO.2]. Problem Analysis:** Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

**[PO.3]. Design/ Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.

**[PO.4]. Conduct investigations** of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.

**[PO.5]. Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

**[PO.6]. The Engineer and Society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.

**[PO.7]. Environment and Sustainability:** Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

**[PO.8]. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

**[PO.9]. Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.

- [PO.10]. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.
- [PO.11]. Project Management and Finance:** Demonstrate knowledge and understanding of engineering and management principles and apply these to owners own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- [PO.12]. Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

#### D. Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	20
	Sessional Exam II (Close Book)	20
	Quizzes(10) and Assignment (10)	20
End Term Exam (Summative)	End Term Exam (Close Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Quizzes	3 Quizzes (Close Book)	

#### E. Syllabus

**Working Fluid:** Properties of steam, Steam tables, Steam Generators, Classification, Construction and working of Simple boiler. **Refrigeration and Air Conditioning:** Definition, concept, Vapour Compression cycle, C.O.P., working principles and schematic diagrams of Refrigerator, Air Conditioner. **Internal Combustion Engine:** Classification, Otto and Diesel cycles, Construction and working of SI and CI engine, Two stroke and Four stroke engine, Calculation of thermal efficiency of cycles. Introduction of **Lubrication:** Need, Methods of lubrication, Splash & Force lubrication. **Steam turbines:** Definition, function, classification and parts of steam turbine, Impulse and reaction turbine - working principle, P – V diagram. **Power Transmission:** Classification and applications of mechanical drives like belts, ropes, chains and gear drives and their velocity ratios, length of belts, power transmitted, ratio of tensions in belts and ropes, gear trains, Calculation of different parameters. **Machine Tools:** Construction, Working and specification of Lathe, Drilling machine, Shaper and Milling machine. **Foundry:** Foundry tools and equipments, Procedure for moulding. **Welding:** Definition, Gas and Arc welding, Soldering and Brazing. **Forging:** Definition, applications, tools Different Forging operations.

#### F. Text Book:

T1. Elements of Mechanical Engineering, Mathur, Mehta and Tiwari, Jain Brother, (Thirteenth Edition), 2016.

#### G. Reference Book:

R1. Thermodynamics: An Engineering Approach, Y.A. Cengel and M.A. Boles, McGraw Hill (Fifth Edition), 2006.

R2. Workshop Technology, Vol. I, W. A. J. Chapman, CBS Publishers & Distributors (Fifth Edition), 2001

## H. Lecture Plan:

Lec No	Topics	Session Objective	Mode of Delivery	Corresponding CO	Mode Assessing Outcome of the
1	Introduction, aims and objectives of the course and elementary fundamentals of thermodynamics	Know the basics of the course and understand its applications	Lecture	ME1001.1	Class Quiz Mid-Term I End-Term
2	<b>Properties of steam:</b> formation of steam experiment	Discuss the terms system and surroundings, thermodynamic properties and describe their use	Lecture	ME1001.1	
3	Different states of steam, enthalpy of steam and Measurement of Dryness fraction	Understand the type of steams	Lecture	ME1001.1	
4	Numerical on properties of steam	Estimating the properties of steam using steam tables.	Lecture/Activity	ME1001.1 ME1001.2	
5	<b>Steam Boilers</b> – definition, function and classification	Know the basics of the steam boiler and understand its applications	Lecture	ME1001.1	
6	Lancashire boiler – construction, working principle and applications	Understand the concept of Lancashire boiler	Lecture	ME1001.1	
7	Boiler mountings & accessories, Comparison between boiler mountings & accessories	Know the basics of the Boiler its accessories and mounting	Lecture	ME1001.1	
8	<b>Refrigeration:</b> Principle and major parts of an refrigeration system and Air Conditioner	Understand various thermodynamic principles related with refrigeration	Lecture/Activity/Lab Visit	ME1001.1	Class Quiz Mid-Term I End-Term
9	Vapour compression refrigeration system: working principle	Know the basics of the Vapour compression refrigeration system	Lecture	ME1001.2 ME1001.3 ME1001.4	
10	Classification of refrigerants and properties of an ideal refrigerant Commonly used refrigerants	Know the criteria in selection of refrigerants and their use	Lecture	ME1001.1	
11	<b>I. C. Engines:</b> classification, parts and I.C Engine terms	Know the basics of the I.C. Engine and understand its applications	Lecture/ Activity/ Lab visit	ME1001.1 ME1001.2	
12	working of four stroke petrol engine	Know the basics of the four S SI engine and understand its applications	Lecture	ME1001.1 ME1001.2	
13	Working of four stroke diesel engine	Know the basics of the four S CI engine and understand its applications	Lecture	ME1001.1 ME1001.2	
14	Two stroke engines and Working of two stroke petrol engine, Working of two stroke diesel engine	Know the basics of the two S Engine and understand its applications	Lecture	ME1001.1 ME1001.2 ME1001.3	
15	comparison between petrol	Analyse the differences	Lecture	ME1001.2	

	& diesel engines			MEI001.3	
16	Comparison between four stroke & two stroke engines and Important definitions	Analyse the differences	Lecture	MEI001.1 MEI001.2 MEI001.3	
17	Problems on I. C. Engines	Estimating the properties of IC Engine	Lecture/Activity	MEI001.2 MEI001.3	
18	<b>Lubrication:</b> Methods of lubrication, Splash & Force lubrication,	Know the basics of the lubrication and understand its applications	Lecture	MEI001.1	Class Quiz Mid-Term II End-Term
19	<b>Steam turbines</b> :definition, function, classification and comparison with steam engine	Know the basics of the steam turbine and understand its applications	Lecture	MEI001.1	
20	Impulse turbine - working principle and P – V diagram, Reaction turbine - working principle,	Understand the impulse and reaction turbine	Lecture	MEI001.1 MEI001.3	
21	Reaction Turbine-PV diagram (Continued),Difference between impulse & reaction turbine	Compare and understand the steam turbines	Lecture	MEI001.3	
22	<b>Power Transmission:</b> Introduction, Significance and definitions, Different methods of power transmission, types of belt drives,	Know the basics of power transmission and understand its applications	Lecture	MEI001.1	Class Quiz Mid-Term II End-Term
23	types of pulleys and its application, V – belt introduction and advantages	Know the type of belt and its use	Lecture	MEI001.1	
24	Derivation of length of belt (open and cross)	Estimate the length of belt drives	Lecture/Activity	MEI001.1	
25	Calculation of Velocity ratio for belt drive, introduction of slip and creep	Estimating the velocity ratio of belt drive	Lecture/Activity	MEI001.3 MEI001.5	
26	Calculation of Tension in belt drive (open), Power transmitted in belt drive and Numerical on belt drives	Estimating the tension in belt	Lecture/Activity	MEI001.3 MEI001.5	
27	Gear drives, types of gears and their application	Know the basics of the gear drives and understand its applications	Lecture	MEI001.1 MEI001.3 MEI001.5	
28	Calculation of velocity ratio for gear drive, gear train (simple and compound)	Estimating the velocity ratio of gear drive	Lecture	MEI001.3 MEI001.5	Class Quiz Mid-Term II End-Term
29	<b>Machine tools:</b> Introduction <b>Lathe-</b> Basic introduction , explanation of principal parts of lathe with the help of diagram and working principle	Know the basics of the machine tool and understand its applications	Lecture	MEI001.1 MEI001.3 MEI001.5	
30	Specification of lathe Machine, Types of operations- Turning, Facing, Knurling, Parting, Grooving, Chamfering, taper turning	Analyse the Lathe Machine and its operation	Lecture	MEI001.1 MEI001.2 MEI001.3 MEI001.5	
31	<b>Drilling:</b> Introduction, classification of drilling machines, operations	Know the basics of the Drilling and understand its applications	Lecture	MEI001.1 MEI001.3	
32	Introduction to Shaper and Milling machine	Know the basics of the Milling and shaper and understand its applications	Lecture/ Workshop Visit	MEI001.1 MEI001.3	

33	<b>Foundry:</b> Usage of Foundry tools and equipments,	Know the basics of the Foundry and understand its applications	Lecture	ME1001.1 ME1001.3 ME1001.5	Class Quiz End-Term
34	Procedure of moulding process	Know the Procedure for moulding.	Lecture	ME1001.1 ME1001.2 ME1001.3 ME1001.5	
35	<b>Welding:</b> Definition, Classification majorly Gas and Arc welding,	Know the basics of the welding and understand its applications	Lecture	ME1001.1 ME1001.2 ME1001.3	
36	Principle of Oxy-Acetylene gas welding, flames and its application	Understand the gas welding	Lecture	ME1001.1 ME1001.2 ME1001.3 ME1001.5	
37	Principle of electric arc welding, Soldering and Brazing.	Understand the arc welding	Lecture	ME1001.1 ME1001.2 ME1001.3	
38	<b>Forging:</b> Definition, applications, tools Different Forging operations	Know the basics of the forging and understand its applications	Lecture/ workshop visit	ME1001.1 ME1001.2 ME1001.3 ME1001.5	

# I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES											
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
<b>ME1001.1</b>	Understand the fundamental concept to the basic elements of mechanical systems while emphasizing the underlying working principles important in understanding the functioning of mechanical systems and processes.	3											
<b>ME1001.2</b>	Apply laws of thermodynamics on engineering processes.	3	2										
<b>ME1001.3</b>	Design and analyse the concept of components, (I.C. engine, Steam generator, Refrigerator, turbine, Machine tools, power transmitting devices and Manufacturing processes etc.).	3		3	2								
<b>ME1001.4</b>	Analyse the concept of second law and entropy in the context of thermal applications.	3	2	3	2		2	2					
<b>ME1001.5</b>	Apply the concept of thermodynamics and manufacturing processes to design/utilize the power generating, power consuming and manufacturing devices.	3	3	3			2	2					



**MANIPAL UNIVERSITY JAIPUR**  
School of Automobile, Mechanical and Mechatronics

**DEPARTMENT OF MECHANICAL ENGINEERING**

Course Hand-out

Engineering Graphics| ME I002 | 3 Credits | 0 0 6 3

Session: July 19 – Nov 19 | Course Coordinator: Dr. Mithilesh Kumar Dikshit | Class: I Year B.Tech

**A. Introduction:** This course teaches the basics of engineering drawing utilising free hand sketching, mechanical drawing, and computer aided drafting. The fundamental principles of orthographic projection as well as the topics of dimensioning, sectional views, isometric and perspective pictorials views, descriptive geometry and assembly drawings are taught.

**B. Course Outcomes:** Upon successful completion of this course:

[MEI002.1]. Students will be able to understand the conventions and the methods of engineering drawing.

[MEI002.2]. Students will be able to understand the theory of projections. Draw orthographic projection of lines, planes and solids.

[MEI002.3]. Students will learn to apply sectional views to most practically represent engineered parts.

Students will have skill to prepare basic engineering models.

[MEI002.4]. Student will learn design and drafting in autocad. Understand the application of industry standards and techniques applied in engineering graphics.

**C. Program Outcomes and Program Specific Outcomes**

[PO.1] **Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

[PO.2] **Problem Analysis:** Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

[PO.3] **Design/ Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.

[PO.4] **Conduct investigations** of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.

[PO.5] **Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

**[PO.6] The Engineer and Society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.

**[PO.7] Environment and Sustainability:** Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

**[PO.8] Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

**[PO.9] Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.

**[PO.10] Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.

**[PO.11] Project Management and Finance:** Demonstrate knowledge and understanding of engineering and management principles and apply these to owners own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

**[PO.12] Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

**D. Assessment Plan:**

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Performance on sheets (Manual Drawing)	30
	Performance on AUTOCAD	20
	Viva voce	10
End Term Exam (Summative)	End Term Exam	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester Examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to his/her faculty about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	

## **E. Syllabus**

Principle of Orthographic Projections: Points, straight lines parallel to one ref. plane (HP/VP) and inclined to other ref. plane; Straight lines inclined to both HP and VP; Straight lines inclined to both HP & VP and parallel to PP; Straight lines with traces; Practical problems on straight lines. Projections of Plane surfaces: Perpendicular one ref. plane ( HP/VP ) and inclined to other ref. plane, Inclined to both HP & VP, Inclined to both HP & VP and perpendicular to PP. Projections of Solids (right regular) by change of position method: Axis parallel to one ref. plane (HP/VP) and inclined to other ref. plane, Resting on one of the ref. plane, axis inclined to both HP & VP, Suspended freely, axis inclined to both HP & VP, Axis inclined to both HP & VP parallel to PP. Projections of solids by Auxiliary plane method: Axis inclined to both HP and VP. Sections of solids (right regular and no spheres): Using Horizontal and vertical section planes using section plane perpendicular to one ref. plane and inclined to the other ref. plane, Given the regular true shapes of various solids and find the inclination of section plane. Development of surfaces: Parallel line development, Radial line development, Triangulation development. Isometric projections: Plane surfaces and simple solids (prisms & cylinders), Frustum and combination of solids, Simple machine elements. Introduction to Computer Aided Drafting.

## **F. Text Books:**

1. Bhat N. D., Engineering Drawing Charotar Publishing House, Anand , 2000.
2. Jeyapooan T. Engineering Drawing and graphics Using AutoCAD, 3<sup>rd</sup> Ed. Vikas Publishing House Pvt. Ltd.,2010.

## **G. Reference Books:**

1. Gopalkrishna K. R., Engineering Graphics, Suhas Publications, Bangalore, 2001.
2. Venugopal K., Engineering Drawing and Graphics + Autocad Newage International Publishers, Delhi (2001).
3. Narayana K. L. and Kannaiah P., Text book on Engineering Drawing, Scitech Publications, Chennai (2002).

## **H. List of Sheets**

1. Projection of Points
2. Projection of Lines (inclined to one plane and parallel to other)
3. Projection of Lines inclined to both the planes and Traces of a line
4. Projection of Planes
5. Projection of Solids
6. Projection of Sections of Solids & Development of Surfaces
7. Isometric projections

## **CAD**

1. Introduction to Auto-CAD and commands
2. Questions on projection of lines
3. Questions on projection of lines inclined to both the planes
4. Questions on projection of planes
5. Basic concept of 3D drafting and drawing

## I. Lecture Plan:

Lecture Number	Topics	Session Outcomes	Mode of delivery	Corresponding CO	Assessments
1	Introduction to Engineering Graphics	Layout of drawing sheet, conventions, scales, Dimensioning, Letterings and Numberings	Board/PPT	MEI002.1	Sheet performance in class/End terms
2	Theory of projection. Projection of Points	Types of Projections, orthographic projections, plane of projection, Quadrants, Angles of projections	Board/PPT	MEI002.1	
3	Problems on projection of points	Position of point, to find distance between any two points	Board/PPT	MEI002.1	
4	Projection of lines inclined to one plane and perpendicular to another plane	Position and projection of straight line, Methods for determining true length and true inclinations.	Board/PPT	MEI002.2	Sheet performance in class/End terms
5	Problems practice of lines inclined to one plane and parallel to other plane	Classroom practice.	Board/PPT	MEI002.2	
6	Projection and traces of straight line inclined to both planes	Projection of straight line inclined to both planes, determining apparent top view and apparent front view, angle of inclinations with both the planes.	Board/PPT	MEI002.2	
7	Problems practice on Lines inclined to both planes and traces of a line	Projection of straight line and traces.	Board/PPT	MEI002.2	
8	Projection of planes	Introduction to plane, location of plane, types of planes, Projection concepts	Board/PPT	MEI002.2	Sheet performance in class/End terms
9	Problems practice on projection of planes inclined to one plane and planes inclined to both planes	Projection of planes, perpendicular planes, plane inclined to	Board/PPT	MEI002.2	

		reference planes			
10	Projection of Solids (right regular and by change of position method)	Introduction, types of solids, position of solids w.r.t. HP and VP	Board/PPT	ME1002.2	Sheet performance in class/End terms
11	Problems practice on projection of solids	Projection of solids in simple positions, Position of solids in typical positions	Board/PPT	ME1002.2	
12	Problems on projection of solids inclined to both planes	Oblique solids, Frustum of cone and Pyramid, Truncated solids	Board/PPT	ME1002.2	
13	Problems on projection of solids	suspended freely and axis inclined to both planes, Axis inclined to both HP & VP, parallel to PP	Board/PPT	ME1002.2	
14	Problems on projection of solids	Projection of solids by auxiliary plane method; Axis inclined to both HP & VP	Board/PPT	ME1002.2	
15	Projection of sections of solids	Introduction, section of solids, Different terminology, classifications	Board/PPT	ME1002.3	Sheet performance in class/End terms
16	Projection of sections of solids	Section perpendicular to VP and parallel to HP, Section perpendicular to HP and parallel to VP	Board/PPT	ME1002.3	
17	Problems on projection of sections of solids	Section perpendicular to VP and inclined to HP, Section perpendicular to HP and inclined to VP	Board/PPT	ME1002.3	
18	Development of surfaces	Parallel line development, Radial line development and Triangular development	Board/PPT	ME1002.3	Sheet performance in class/End terms
19	Development of Surfaces	Problems on Development of Surfaces for prism, pyramid, cone cylinder	Board/PPT	ME1002.3	
20	Isometric view and projection	Introduction,	Board/PPT	ME1002.3	Sheet

		Difference between isometric view and isometric projection, Isometric axis, isometric lines and isometric planes			performance in class/End terms
21	Problems on Isometric view and projection of planes and solids	Dimensioning on isometric projection Isometric view and projection of plane geometries, Four center method to draw isometric view and projection of circle, Isometric view of right solids	Board/PPT	ME1002.3	
22	Problems on Isometric projection of planes and solids	Isometric view and projection of Truncated solids, frustum	Board/PPT	ME1002.3	
23	Introduction to Auto CAD	Introduction, CAD applications, AUTOCAD workspace, Setting up drawing space, sheet layout, command execution	PPT	ME1002.4	
24	Commands and Projection of lines and lines inclined to both planes using Auto CAD	Methods of locating a point, Drawing lines and curves, texting and dimensioning of drawings	AUTOAD	ME1002.4	Classroom Test
25	Commands and Projection of planes using AUTOCAD	Drawing of polygons using commands, editing commands like OFFSET, FILLET, CHAMFER, TRIM, EXTEND, BREAK, ROTATE, MIRROR etc.	AUTOCAD	ME1002.4	
26	3D objects	Commands: EXTRUDE, CYLINDER, CONE, BOX, UNION, SUBSTRACT and SECTION	AUTOCAD	ME1002.4	

#### J. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	Correlation With Program Outcomes											
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
<b>ME1002.1</b>	Students will be able to understand the conventions and the methods of engineering drawing.	3	1	2	1								2
<b>ME1002.2</b>	Students will be able to understand the theory of projections. Draw orthographic projections of lines, planes and solids.	3	2	2	1								2
<b>ME1002.3</b>	Students will learn to apply sectional views to most practically represent engineered parts. Students will have <b>skill</b> to prepare basic engineering models.	3	3	3	1								2
<b>ME1002.4</b>	Student will learn <b>design and drafting</b> in autocad. Understand the application of industry standards and techniques applied in engineering graphics.	3	3	3	2	3							2

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**



**MANIPAL UNIVERSITY JAIPUR**  
DEPARTMENT OF Mechatronics ENGINEERING  
Department of Mathematics and Statistics  
Course Hand-out

Engineering Mathematics III | MA 1313 | 3 Credits

Session: July19- Nov 19 | Faculty: Dr. V S Chouhan

- A. Introduction:** This course is offered by Dept. of Mathematics as core subject, targeting students who wish to pursue research & development in industries or higher studies in field of Engineering Mathematics. Offers in depth knowledge Laplace and fourier transform, Numerical analysis, Fourier series and vector calculus. Students are expected to have background knowledge on integration and differentiation for a better learning.
- B. Course Outcomes:** At the end of the course, students will be able to
- [1313.1] Analysis the problems of engineering by using Numerical analysis.
  - [1313.2] Solve the differential equations by using Laplace and Fourier transform.
  - [1313.3] Study the Flux and motion of fluid in the vector field.
  - [1313.4] Analysis and study the properties of periodic functions by Fourier series.
- C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES**
- [PO.1].Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- [PO.2].Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
- [PO.3].Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
- [PO.4].Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
- [PO.5].Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
- [PO.6].The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice
- [PO.7].Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
- [PO.8].Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices
- [PO.9].Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

**[PO.10]. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

**[PO.11]. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

**[PO.12]. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

**[PSO.1].** Apply the knowledge of basic sciences, analytical skills and modern computing tools to design, perform and analyse experiments to meet desired goals within the given constraints.

**[PSO.2].** Apply concepts of circuit analysis, analog and digital electronics, controls, electric drives, instrumentation, power systems, machine learning and artificial intelligence to design and automation of mechatronics systems.

**[PSO.3].** Use the principles of solid mechanics, fluid mechanics, strength of materials, advanced functional materials and manufacturing processes to design, manufacture, and commissioning of mechatronics systems.

#### D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	15
	Sessional Exam II (Close Book)	15
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam (Close Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

#### E. SYLLABUS

**Vector Calculus:** gradient, divergence and curl, vector integrals, related theorems, **Laplace Transforms:** Transforms of elementary functions, inverse transforms, convolution theorem. Application of Laplace in solutions of differential equations with constant coefficients.

**Fourier series:** Fourier series, Dirichlet's, even and odd functions, half range series, change of interval, harmonic analysis.

**Fourier Transforms:** Fourier integrals, Complex Fourier transform, Fourier sine and cosine transforms, solution of heat and wave equations.

**Finite Differences and Interpolation:** Finite difference operators, Newton's forward and forward interpolation formula, Lagrange's and Stirling interpolation formula. Numerical differentiation and integration.

**Text Books:**

1. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, Delhi, 2006.
2. Srimanta Pal, Subhdi C. Bhunia, "Engineering Mathematics", Oxford University Press, 2015.
3. H. K. Das, "Advanced Engineering Mathematics" S. Chand, 2015.

**References:**

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India Eastern, 2006.
2. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill Education Private Limited, New Delhi 2007.

**F. Lecture Plan:**

Description of the Topics	Required Lectures	Cumulated Lectures
<b>Laplace Transform:</b>		
Definition of LT. LT of elementary functions, Sectionally Continuous and Exponential order, Existence theorem	1	1
Properties of LT: linearity, First shifting, second shifting, change of scale, Multiplication by $t$ , division by $t$ , Derivative property, Integral Prop., Initial Value Problem, Final Value Problem (Without Proof)	3	4
Inverse transforms, convolution theorem.	2	6
Application of Laplace in solutions of differential equations with constant coefficients.	1	7
<b>Finite Differences and Interpolation</b>		
Finite difference operators	1	8
Newton's- Gregory forward and backward interpolation formula,	2	10
Stirling interpolation & Lagrange's	2	12
Numerical Differentiation (For Forward, Backward, Stirling)	2	14
Numerical Integration( Quadrature formula, Trapezoidal rule, Simpson 1/3rule, Simpson's 3/8 rule, Weddle rule	3	17
<b>Vector Calculus:</b>		
gradient, divergence and curl	3	20
vector integrals	3	23
Greens, Stokes and Gauss Divergence theorem	4	27
<b>Fourier series:</b>		
Fourier series, Dirichlet Condition	2	29
even and odd functions half range series	1	30
change of interval	2	32
Harmonic analysis	2	34

<b>Fourier Transforms:</b>		
Fourier integrals	1	35
Complex Fourier transform, Fourier sine and cosine transforms,	2	37
Properties of Fourier Transform	2	39
solution of heat and wave equations	3	42

**END SEMESTER EXAMINATION**

**G. Course Articulation Matrix: (Mapping of COs with POs)**

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MA1313.1	Analysis the problems of engineering by using Numerical analysis.	2									2			1		
MA 1313.2	Solve the differential equations by using Laplace and Fourier transform.	2			1										2	
MA 1313.3	Study the Flux and motion of fluid in the vector field.	2				1										1
MA 1313.4	Analysis and study the properties of periodic functions by Fourier series.	2									1					

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**



# MANIPAL UNIVERSITY JAIPUR

School of Humanities and social sciences

Department of Economics

Course Hand-out

Economics | EO 1323 | 3 Credits | 3 0 0 3

Session: July 19 – Nov 19 | Faculty: Dr Manas Roy | Class: Core

**A. Introduction:** This course is offered by Dept. of Economics to the Engineering departments, targeting students to give basic understanding in the concept of economics. It mainly deals with economic issues related to consumer behaviour, firms, industries and business organizations to make aware the students regarding economic environment. This course also discusses the preliminary concepts associated with macroeconomic variable like GDP inflation, balance of payments etc. It explores various possibilities emerging in an economy and the role of economic policy in this context.

**B. Course Outcomes:** At the end of the course, students will be able to

- [1323.1] Describe the basic principles of micro and macroeconomic analysis.
- [1323.2] Interpret and illustrate decision making process in practical life.
- [1323.3] Aware of the tools and techniques of economics for real world.
- [1323.4] Recognize the problems and give solutions to it.
- [1323.5] Recall the assumptions that underpin the Micro/Macro model.

## C. Program Outcomes and Program Specific Outcomes

- [PO.1]. Engineering knowledge:** Demonstrate and apply knowledge of Mathematics, Science, and Engineering to classical and recent problems of electronic design & communication system.
- [PO.2]. Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- [PO.3]. Design/development of solutions:** Design a component, system, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- [PO.4]. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
- [PO.5]. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
- [PO.6]. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

- [PO.7]. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
- [PO.8]. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices
- [PO.9]. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
- [PO.10]. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
- [PO.11]. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments
- [PO.12]. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
- [PSO.1].** Apply the knowledge of basic sciences, analytical skills and modern computing tools to design, perform and analyze experiments to meet desired goals within the given constraints.
- [PSO.2].** Apply concepts of circuit analysis, analog and digital electronics, controls, electric drives, instrumentation, power systems, machine learning and artificial intelligence to design and automation of mechatronics systems.
- [PSO.3].** Use the principles of solid mechanics, fluid mechanics, strength of materials, advanced functional materials and manufacturing processes to design, manufacture, and commissioning of mechatronics systems.

#### D. Assessment Plan:

Criteria	Description	Maximum Marks
Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I	15
	Sessional Exam II	15
	Assignments , Activity, etc.	30
End Term Exam (Summative)	End Term Exam	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these	

## **E. SYLLABUS**

Definition, nature and scope of economics; Introduction to micro and macroeconomics; law of demand and supply; elasticity of demand and supply; cardinal and ordinal approaches of utility; production, laws of production; cost and revenue analysis; various market situations; Break even analysis; Capital budgeting Macro Economics: National income and its concepts, value of money and its changes; foreign exchange rate; monetary and fiscal policies and other macro concepts (Balance of payments, Business cycles etc.)

## **F. TEXT BOOKS**

- P. Samuelson and Nordhaus, Economics, 19<sup>th</sup> Edition, Tata McGraw-Hill, 2008.
- Dornbusch, Fischer and Startz Macroeconomics, McGraw Hill, 2010
- H C Peterson, Managerial economics, Pearson, 9<sup>th</sup> Edition, 2012

## **G. REFERENCE BOOKS**

- P L Mehta, Managerial Economics, S Chand and company pvt. limited, New Delhi, 2012
- H L Ahuja, managerial economics, S Chand and company pvt. Limited, 2010
- H.L. Ahuja, Advanced Economic Theory: Microeconomic Analysis, S. Chand and Co. Limited, New Delhi, 2007
- Lipsey & Chrystal, Economics, Oxford University Press, 2011.
- Richard T. Froyen, Macroeconomics, Pearson Education Asia, 2005

**H. Lecture Plan:**

<b>Lec No</b>	<b>Topics</b>	<b>Session Outcome</b>	<b>Mode of Delivery</b>	<b>Corresponding CO</b>	<b>Mode of Assessing the Outcome</b>
1	Overview of the course structure	To acquaint and clear the overview of the course	Lecture	NA	NA
2	Objective of the course	Discussion of the objective of the course for the engineers	Lecture	NA	NA
3,4	Definition, nature and scope of economics, introduction to micro and macroeconomics	Describe the concept given by different economists, its scope, differences between micro and macro economics	Lecture	I323.1	Class Test Mid Term I
5,6,7,	Cardinal approaches of utility	Describe the concept of cardinal approach of utility, Law of DMU and equi marginal utility	Lecture	I323.1	Class Test Mid Term I
8,9,10,11	Law of demand and supply, elasticity of demand and supply	Describe the concept of demand, supply, elasticity of demand and supply with examples, conceptual questions	Lecture	I323.1	Class Test Mid Term I
12	Revision of previous lectures	Recall all the concepts discussed in previous classes	Lecture	I323.5	Class Test Mid Term I End Term
13	Discussion of the topics related to assignment	Discussion about the assignment topics	Lecture, Activity		Home Assignment Mid Term I End term
14,15,16	Ordinal approaches of utility	Recall of the differences between the concept of the cardinal approach and ordinal approach of utility , IC analysis, Consumers equilibrium, IE,SE,PE	Lecture	I323.5	Class Test Mid Term I End Term
17,18,19	Production, laws of production	Discussion of the concept of production, recognize production function, producers equilibrium, RTS	Lecture	I323.4	Class Test Mid Term II End Term
20,21	Cost and revenue analysis	Discussion of the concept of cost and cost function, recognize SR and LR cost curves, revenues	Lecture	I323.4	Class Test Mid Term II End Term
22,23	Various market situations; Break even analysis	Aware of market morphology with examples, Interpret and illustrate BEA	Lecture	I323.3	Class Test Mid Term II End Term
24	Revision of previous lectures	Recall all the concepts discussed in previous classes	Lecture	I323.5	Class Test Mid Term II End Term
25	Discussion of the topics related to assignment	Recall the discussion about the	Lecture, Activity	I323.5	Home Assignment

		assignment topics			Mid Term II End term
26	Capital budgeting	Interpret and illustrate the concept of CB and various tools	Lecture	I 323.2	Home Assignment Class Test End Term
27,28	Macro Economics: National income and its concepts	Interpret and illustrate the concept of NI,GDP,GNI,PI etc., circular flow	Lecture	I 323.2	Home Assignment Class Test End Term
31,32,33	Monetary and fiscal policies	Concept of monetary and fiscal policies, Aware of its instruments, importance and limitations	Lecture	I 323.3	Home Assignment Class Test End Term
34,35	Inflation	Concept of inflation, Aware of demand pull and cost push inflation	Lecture	I 323.3	Home Assignment Class Test End Term
36,37	Various macro concepts: Balance of payments, Business cycles	Aware of the concept of BOP, Business cycles	Lecture	I 323.3	Home Assignment Class Test End Term
38	Discussion of the topics related to end sessional examination	Recall the discussion about the assignment topics	Lecture	I 323.5	End Term
39	Conclusion and Course Summarization	Recall all the concepts discussed in previous classes	Lecture	I 323.5	End Term

**I. Course Articulation Matrix: (Mapping of COs with POs)**

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EO 1323. 1	Describe the basic principles of micro and macroeconomic analysis									1		2	2			
EO 1323. 2	Interpret and illustrate decision making process in practical life						1			2			2			
EO 1323. 3	Aware of the tools and techniques of economics for real world									2		2	2			
EO 1323. 4	Recognize the problems and give solutions to it									2		2	2			
EO 1323. 5	Recall the assumptions that underpin the Micro/Macro model.									2			2			

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**



## MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Mechatronics Engineering

Course Hand-out

Strength of Materials | MC1306 | 4 Credits | 4 0 0 4

Session: July 19 – Nov 19 | Faculty: Hemant Kumar | Class: Departmental Core (III sem)

**A. INTRODUCTION:** This course is offered by Dept. of Mechatronics Engineering as departmental core. Strength of Materials is a fundamental subject needed primarily for the students of Mechanical sciences. As the engineering design of different components, structures etc. used in practice are done using different kinds of materials, it is essential to understand the basic behaviour of such materials. The objective of the present course is to make the students acquainted with the concept of load resultant, consequences and how different kinds of loadings can be withstood by different kinds of members with some specific materials.

**B. COURSE OUTCOMES:** At the end of the course, students will be able to

[MC1306.1] Predict the changes in the mechanical behaviour of materials due to the forces applied on physical models

[MC1306.2] Interpret and quantitatively determine standard mechanical properties from stress-strain diagram.

[MC1306.3] Recognize the fundamental concepts of mechanics of deformable solids; including static equilibrium, geometry of deformation, and material constitutive behaviour.

[MC1306.4] Create interest to explore the analysis and design of engineering structure considering factors of deflection, buckling, and combined loading and failure theories to enhance employability skills

[MC1306.5] To build the necessary theoretical background for further structural analysis and design courses.

### C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1].**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

[PO.2].**Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

[PO.3].**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

[PO.4].**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

[PO.5]. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations [PO.6].**The engineer and society:** Apply reasoning informed by the contextual

knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

**[PO.7]. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

**[PO.8]. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices

**[PO.9]. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

**[PO.10]. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

**[PO.11] Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

**[PO.12]. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

**[PSO.1].** Apply the knowledge of basic sciences, analytical skills and modern computing tools to design, perform and analyse experiments to meet desired goals within the given constraints.

**[PSO.2].** Apply concepts of circuit analysis, analog and digital electronics, controls, electric drives, instrumentation, power systems, machine learning and artificial intelligence to design and automation of mechatronics systems.

**[PSO.3].** Use the principles of solid mechanics, fluid mechanics, strength of materials, advanced functional materials and manufacturing processes to design, manufacture, and commissioning of mechatronics systems.

#### D. Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	15
	Sessional Exam II (Closed Book)	15
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam (Close Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity classroom participation by a student will be assessed and marks will be awarded.	

#### E. SYLLABUS:

Stress, Strain and Deformation of Solids: Rigid and Deformable bodies, Strength, Stiffness and Stability, Stresses; Tensile, Compressive and Shear, Deformation of simple and compound bars under axial load, Thermal stress, Elastic constants, Strain energy and unit strain energy, Strain energy in uniaxial loads, Beams-Loads and Stresses: Types of beams: Supports and Loads, Shear force and Bending Moment in beams, Cantilever, Simply supported and Overhanging beams, Stresses in beams, Theory of simple bending, Stress variation along the length and in the beam section , Effect of shape of beam section on stress induced , Shear stresses in beams, Shear flow, Torsion: Analysis of torsion of circular bars, Shear stress distribution, Bars of Solid and hollow circular section, Stepped shaft, Twist and torsion stiffness, Fixed and simply supported shafts, Beam deflection: Elastic curve of Neutral axis of the beam under normal loads, Evaluation of beam deflection and slope, Columns, End condition, Equivalent length of a column, Euler equation, Slenderness ratio, Rankine formula for columns, Analysis of stresses in two dimensions: Biaxial state of stresses, Thick & Thin cylindrical shells and spherical shells, Deformation in thick & thin cylindrical and spherical shells, Biaxial stresses at a point, Stresses on inclined plane, Principal planes and stresses, Mohr's circle for biaxial stresses, Maximum shear stress.

#### Text Books:

1. E. P. Popov, Engineering Mechanics of Solids, Prentice-Hall of India, New Delhi, 2nd edition, 1998
2. F. P. Beer and R. Johnston, Mechanics of Materials, McGraw-Hill Book Co, 7th edition, 2014.

References:

1. W. A. Nash, Theory and problems in Strength of Materials: Schaum's Outline Series, McGraw-Hill Book Co, 4th Edition, New York 2010.
2. S. M. A. Kazimi, Solid Mechanics, Tata McGraw-Hill, New Delhi, 1st edition, 2001.
3. G. H. Ryder, Strength of Materials, Macmillan India Ltd., 3rd Edition, 2002.
4. Ray Hulse, Keith Sherwin & Jack Cain, Solid Mechanics, Palgrave ANE Books, 2004.
5. D. K. Singh, Mechanics of Solids, Pearson Education, 1st edition, 2002.
6. S. Timoshenko, Elements of Strength of Materials, Tata McGraw-Hill, New Delhi, 5th edition, 2011.

### F. Lecture Plan:

Lec. No	Topics	Session Objective	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction and Course Hand-out briefing	To acquaint and clear teachers expectations and understand student expectations	Lecture	NA	NA
2	Introduction , strength of material, Introduction to Stress-Strain diagrams for Ductile and Brittle materials	To understand the importance of Stress-Strain diagrams for materials	Lecture	CO.1	In Class Quiz ( Not Accounted)
3,4	Strain Energy, Resilience, Toughness, Hardness, Creep & Temperature, contact stresses, Material Specification	Few definitions for understand the nature of the material properties	Lecture	CO.1	In Class Quiz
5,6	Deformation of simple and compound bars under axial load	Physical meaning of the terms and its usage	Lecture	CO.1	Home Assignment
7.-10	Thermal Stress and strain calculation for composite beam, Numerical practices on thermal stress-strain	To practice numerical on Thermal Stresses	Lecture,	CO.1 & CO.2	In Class Quiz
11	Elastic constants, Strain energy and unit strain energy	Study of Strain Energy and Elastic Constant	Lecture,	CO.2	Home Assignment
12-14	Loads and Stresses: Types of beams, supports and loads, Shear force diagram(SFD) and Bending Moment diagram(BMD), Numerical Practice	Study and practice to check the stresses in system	Lecture	CO.2	Class Quiz
15	Cantilever Beam and related Numerical Problems	To practice the numerical	Lecture	CO.3	Class Quiz
16-17	Simply Supported Beam and related Numerical Problems	To make understand the SFD and BMD	Design Data Book	CO.3	Class Quiz
18-19	Overhanging Beam and related Numerical Problems	Acquaint students about the application of formulas	Lecture	CO.3	Class Quiz, Case Study
20	Theory of Simple bending Stress, Stress variation along the length and in the beam section	Acquaint students about the application of formulas	Flipped Classroom	CO.3	Class Quiz
21	Effect of shape of beam section on stress induced, Shear stresses in beams, Shear flow	Acquaint students about the application of formulas	Flipped Classroom	CO.4	Class Quiz

22-23	Torsion of circular bars, Shear stress distribution	Make students to use formula to solve numerical	Lecture	CO.4	Class Quiz
24-25	Bars of solid and hollow circular section, Stepped shaft, Numerical Practices	Make students to use formula to solve numerical	Lecture	CO.4	Class Quiz

26	Twist and torsion stiffness, Fixed and simply supported beams,	Make students to use formula to solve numerical	Lecture	CO.4	Home Assignment
27	Numerical Practices	Make students to use formula to solve numerical	Lecture	CO.4	Class Quiz
28-29	Elastic curve of neutral axis of the beam under normal loads	Acquaint students about the application of formulas	Lecture	CO.4	Class Quiz
30-31	Beam deflection and its slope, Macaulay's Method	Acquaint students about the application of formulas	Lecture	CO.4	Class Quiz
32-33	Numerical Practices on various types of beams	Make students to use formula to solve numerical	Lecture	CO.4	Class Quiz
34-36	Columns , End conditions, Equivalent length of a column, Formula Derivation	Make students to use formula to solve numerical	Lecture	CO.4	Class Quiz
37-38	Numerical Practices	Make students to use formula to solve numerical	Lecture	CO.4	Class Quiz
39-40	Euler equation, Slenderness ratio and numerical practices	Acquaint students about the application of basic formulas	Lecture	CO.5	Class Quiz
41-42	Introduction to analysis of stresses in two dimensions	Application of formulas	Lecture	CO.5	Class Quiz
43-44	Biaxial state of stresses, Numerical practices	Make students to use formula to solve numerical	Lecture	CO.5	Class Quiz
45	Thick and thin cylindrical shells	Make students to use formula to solve numerical	Lecture	CO.5	Class Quiz
46	Deformations, Biaxial stresses at a point	Make students to use formula to solve numerical	Lecture	CO.5	Class Quiz
47-48	Stresses on inclined plane, Principal planes and stresses	Application of formulas	Lecture	CO.5	Class Quiz
49-51	Mohr's circle for biaxial stresses and Numerical Practice	Make students to use formula to solve numerical	Lecture	CO.5	Class Quiz

# **I. Course Articulation Matrix: (Mapping of COs with POs)**

CO	STATEMENT	CORRELTION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MC 1306.1	Course Outcome statement	3	2			3								2		3
MC 1306.2	Course Outcome statement	2	1		2	3								2		3
MC 1306.3	Course Outcome statement	3		3	3	2								2		2
MC 1306.4	Course Outcome statement	3	2	2		2								2		2
MC 1306.5	Course Outcome statement	3		1		3								2		1

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**



**MANIPAL UNIVERSITY JAIPUR**  
School of Automobile Mechanical and Mechatronics Engineering  
Department of Mechatronics Engineering  
Course Hand-out

Electronic Measurement and Instrumentation | MC1307 | 4 Credits | 4 0 0 4

Session: July 19 – Nov 19 | Faculty: Shahbaz Ahmed Siddiqui | Class: Core Subject

**A. INTRODUCTION:** This course is electronics based course dealing with measurements and instrumentation designed for students in Physics Electronics, Electrical and Electronics Engineering and allied disciplines. It is a theory course based on the use of electrical and electronics instruments for measurements. The course deals with topics such as Principle of measurements, Errors, Accuracy, Units of measurements and electrical standards, , introduction to the design of electronic equipment's for temperature, pressure, level, flow measurement, resistance, speed etc.

**B. COURSE OUTCOMES:** At the end of the course, students will be able to

**CO.1 [MC1307.1]** Measure various electrical parameters with accuracy, precision, resolution and understand the errors associated in the measuring devices.

**CO.2 [MC1307.2]** Explain the use of various electrical/electronic instruments, their construction, principles of operation, standards and Applications

**CO.3 [MC1307.3]** Analyse different techniques for measurement of inductance, capacitance and resistance employing AC/DC bridges.

**CO.4 [MC1307.4]** Select appropriate passive or active transducers for measurement of physical phenomenon like temperature, pressure and understand their operation & Construction.

**CO.5 [MC1307.5]** Methods & Techniques for flow, liquid level, displacement measurement and develop skill for use of these techniques in Industry/Laboratory applications.

**C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES**

**[PO.1].Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

**[PO.2].Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

**[PO.3].Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

**[PO.4].Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

**[PO.5]. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

**[PO.6].The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

**[PO.7]. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

**[PO.8]. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices

**[PO.9]. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

**[PO.10].Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

**[PO.11] Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

**[PO.12]. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

**[PSO.1].** Apply the knowledge of basic sciences, analytical skills and modern computing tools to design, perform and analyse experiments to meet desired goals within the given constraints.

**[PSO.2].** Apply concepts of circuit analysis, analog and digital electronics, controls, electric drives, instrumentation, power systems, machine learning and artificial intelligence to design and automation of mechatronics systems.

**[PSO.3].** Use the principles of solid mechanics, fluid mechanics, strength of materials, advanced functional materials and manufacturing processes to design, manufacture, and commissioning of mechatronics systems.

### **Class Schedule:**

3 hours a week, 60 minutes a lecture, 45 lectures a semester.

### **Contribution of Courses to Meeting Professional Components:**

- Basic math and science
- Engineering topics

### **Text Books:**

1. A.K. Sawhney, Electrical & Electronic Measurements and Instrumentation, Dhanpat Rai & Co, New Delhi, 19<sup>th</sup> Edition, 2011.
2. E. O. Doebelin, Measurement Systems: Application and Design, McGraw Hill, New York, 6<sup>th</sup> Edition, 2012.

### **References:**

1. D. Patranabis, Principles of Industrial Instrumentation, Tata McGraw Hill, New Delhi, 3<sup>rd</sup> Edition, 2010.
2. A. K. Sawhney, A course in Mechanical Measurement and Instrumentation, Dhanpat Rai and Co, New Delhi, 12<sup>th</sup> edition, 2002.
3. Bela G. Liptak, Process Measurement and Analysis, Chilton Book Company, Pennsylvania, 4<sup>th</sup> Edition, 2012

**Assessment Rubrics:**

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	15
	Sessional Exam II (Closed Book)	15
	Tutorial	5
	Assignment	15
End Term Exam (Summative)	Quiz	10
	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity classroom participation by a student will be assessed and marks will be awarded.	

**SYLLABUS:**

Basic concepts of measurements: System configuration, calibration - Errors in measurements, measuring instruments: Permanent magnet moving coil, Moving iron, Electrodynamometer type and Rectifier type instruments, Applications - Measurement of Resistance, Inductance & Capacitance: A.C. Bridges. Temperature Measurement: Temperature and heat, Definitions, temperature scales, bimetallic thermometers, filled-bulb and glass stem thermometers, Resistance Temperature Detector (RTD), principle and types, measuring circuits, Linear and Quadratic approximation Thermistors, Thermocouples, optical pyrometers, Pressure Measurement: Manometers, Elastic types, Bell gauges, Electrical types, Differential Pressure transmitters, Dead weight Pressure gauges, Low Pressure Measurement: McLeod gauge, Knudsen gauge, Pirani gauge, Thermal conductivity gauges, Ionization gauge. Flow measurement: Classification of flow meters, orifice meters, Venturi Flow meter, variable area flow meters, Laser Doppler Anemometer (LDA), ultrasonic flow meters, Doppler flow meters, V-cone flow meters, purge flow regulators, Measurement of mass flow rate: Radiation, angular momentum, Displacement measurement (LDR, Photodiode, LVDT), Vibration measurement, Level Measurement, Angular Velocity Measurement

**Lecture Plan:**

Lec. No	Topics	Session Objective	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction and Course Hand-out briefing	To acquaint and clear teachers expectations and understand student expectations	Lecture	NA	NA
2	Introduction to Measurement and Instrumentation ,Significance of Measurement	To understand the importance of measurement	Lecture	CO.1 & CO.2	In Class Quiz ( Not Accounted) End Term Mid term 1
3,4	Methods of Measurement	Few definitions for measurement analysis	Lecture	CO.1 & CO.2	In Class Quiz End Term Mid term 1
5,6	Characteristics of Instruments and Measurement Systems	Physical meaning of the terms and its usage	Lecture	CO.1 & CO.2	Home Assignment End Term Mid term 1
7.-10	Continued, Applications of Measurement System, Calibration - Errors in measurements	Acquaint students on the applications	Lecture, Flipped Classroom	CO.1 & CO.2	In Class Quiz End Term Mid term 1
11	Tutorial	To practice numerical on errors	Quiz	CO.1 & CO.2	Home Assignment Class Quiz
12-14	Permanent magnet moving coil: Introduction, Working, Numerical	Study of electrical instruments	Lecture	CO.3	Class Quiz End Term Mid term 1
15,16	Moving Iron Instruments: Introduction, Working, Numerical	Study of electrical instruments	Lecture	CO.3	Class Quiz End Term Mid term 1
17	Electrodynamometer type Instruments	Study of electrical instruments	Lecture	CO.3	Class Quiz

					End Term Mid term 1
18-19	Rectifier type of instruments	Study of electrical instruments	Software Learning	CO.3	Class Quiz End Term Mid term 1
20	Difference amplifier, instrumentation amplifier and bridge amplifier	Study of amplifiers ad different types	Flipped Classroom	CO.2 & CO.3	Class Quiz End Term Mid term 1
21	Introduction to Bridges	Study of Measurement of resistance, inductance and capacitance using bridges	Flipped Classroom	CO.4	Class Quiz End Term Mid Term 2
22-24	Kelvin's Double bridge, Wheatstone Bridges Numerical	Study of Measurement of resistance, inductance and capacitance using bridges	Lecture	CO.4	Class Quiz End Term Mid Term 2
25	Loss of charge method, Murray Loop Test	Study of Measurement of resistance, inductance and capacitance using bridges	Lecture	CO.4	Class Quiz End Term Mid Term 2
26	Introduction to AC Bridges	Study of Measurement of resistance, inductance and capacitance using bridges	Lecture	CO.4	Class Quiz End Term Mid Term 2
27-30	Anderson Bridge, De-Sauty's Bridge Numerical, Phasor Diagrams	Study of Measurement of resistance, inductance and capacitance using bridges	Lecture	CO.4	Class Quiz End Term Mid Term 2
31-32	Schering Bridge , De-sauty's Bridge, Phasor diagram , Numericals	Study of Measurement of resistance, inductance and capacitance using bridges	Lecture	CO.4	Home Assignment End Term Mid Term 2
33-35	<b>Temperature Measurement:</b> Temperature and heat, Definitions, Temperature scales	Study of a transducer used for measuring temperature	Lecture	CO.5	Class Quiz End Term Mid Term 2
36	Bimetallic thermometers	Study of a transducer used for measuring temperature	Lecture	CO.5	Class Quiz End Term Mid Term 2
37	Filled-bulb and glass stem thermometers	Study of a transducer used for measuring temperature	NA, Flipped Classroom	CO.5	NA End Term Mid Term 2
38	Resistance Temperature Detector (RTD), principle and types Measuring circuits	Study of a transducer used for measuring temperature	Practical	CO. 3 & CO.5	End Term Mid Term 2
39-41	Introduction to Thermistors, Linear and Quadratic approximation Thermistors, Numericals	Study of a transducer used for measuring temperature	Lecture	CO.5	End Term Mid Term 2

42	Thermocouples, Types, Properties Applications	Study of a transducer used for measuring temperature	Practical	CO. 3 & CO.5	End Term Mid Term 2
43	<b>Pressure Measurement:</b> Manometers	Study of a transducer used for measuring pressure	Lecture	CO.5	End Term
44	U type Manometers, Well type Manometers, bell gauges	Study of a transducer used for measuring pressure	Lecture	CO. 3 & CO.5	End Term
45	Tutorial	To evaluate the students	Quiz	CO.5	End Term
46-48	Electrical types, Differential Pressure transmitters, Dead weight Pressure gauges, Low Pressure Measurement: McLeod gauge, Knudsen gauge, Pirani gauge	Study of a transducer used for measuring pressure	Lecture	CO. 3 & CO.5	End Term
49	Thermal conductivity gauges, Ionization gauges	Study of a transducer used for measuring pressure	Seminar	CO. 3 & CO.5	End Term
50-51	<b>Flow Measurement:</b> Classification of Flow meter, Laser Doppler Anemometer, Ultrasonic Flow meter	Different types of transducer used for measuring flow measurement	Lecture	CO. 3 & CO.5	End Term
52	Measurement of Mass Flow rate: Displacement (LVDT)	Different types of transducer used for measuring flow measurement	Lecture	CO. 3 & CO.5	End Term
53-55	Angular Velocity Measurement, Angular Momentum Measurement	Different types of transducer used for measuring angular velocity, momentum	Lecture	CO.5	End Term
56	Revision	NA	Quiz	CO.1-CO.5	End Term

# I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELTION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MC 1307.1	Measure various electrical parameters with accuracy, precision, resolution and understand the errors associated in the measuring devices.	3		2											3	
MC 1307.2	Explain the use of various electrical/electronic instruments, their construction, principles of operation, standards and Applications	2		1		1								1	1	
MC 1307.3	Analyse different techniques for measurement of inductance, capacitance and resistance employing AC/DC bridges.	2		1		2								1	3	
MC 1307.4	Select appropriate passive or active transducers for measurement of physical phenomenon like temperature, pressure and understand their operation & Construction	2		2		1								1	2	
MC 1307.5	Methods & Techniques for flow, liquid level, displacement measurement and develop skill for use of these techniques in Industry/Laboratory applications	1		3										1	2	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation



# MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Mechatronics Engineering  
Course Hand-out

Analog System Design | MCI308 | 4 Credits | 3 | 0 | 4

Session: July 19 –Nov 19 | Faculty: Anil Sharma | Class: Department Core

- A. Introduction:** This course is offered by Dept. of Mechatronics Engineering as third semester subject, targeting students who wish to pursue research & development in industries or higher studies in field of Mechatronics Engineering, including electronics system design and VLSI. This course will cover the basic building blocks of linear systems, such as inverting and non-inverting amplifiers, comparators, and filters.

**Course Outcomes:** *At the end of the course, students will be able to*

**[MCI308.1]** Elucidate and design the linear and non-linear applications of an op-amp and special application IC's.

**[MCI308.2]** Apply the working principle of data converters and filters in practical applications.

**[MCI308.3]** Analyse the function of application specific ICs such as Voltage regulators, PLL and its application.

**[MCI308.4]** Assess the DC and AC characteristics of operational amplifiers and its effect on output and their compensation techniques.

**[MCI308.5]** Design waveform generation and PWM circuits using special application IC 555 and general purpose op-amp for specific applications to enhance employability skills.

## **B. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES**

**[PO.1].Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

**[PO.2].Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

**[PO.3].Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

**[PO.4].Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

**[PO.5].Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

**[PO.6].The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

**[PO.7].Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

**[PO.8].Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices

**[PO.9].Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

**[PO.10]. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

**[PO.11]. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

**[PO.12]. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

**[PSO.1].** Apply the knowledge of basic sciences, analytical skills and modern computing tools to design, perform and analyse experiments to meet desired goals within the given constraints.

**[PSO.2].** Apply concepts of circuit analysis, analog and digital electronics, controls, electric drives, instrumentation, power systems, machine learning and artificial intelligence to design and automation of mechatronics systems.

**[PSO.3].** Use the principles of solid mechanics, fluid mechanics, strength of materials, advanced functional materials and manufacturing processes to design, manufacture, and commissioning of mechatronics systems.

### C. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	15
	Sessional Exam II (Closed Book)	15
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 3 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

## **SYLLABUS:**

Operational Amplifier: Introduction: Introduction to analog system design, Review of Op-Amp basics, internal block diagram, characteristics of ideal operational amplifier, Linear applications of operational amplifier: Open loop and closed loop operation of operational amplifier, Inverting amplifier, non-inverting amplifier, various configuration of Op-Amp, Active filters: Design and analysis of first and higher order low pass, high pass, band pass and band elimination and all pass active filters, Non-linear applications of operational amplifier: Precision half wave and full wave rectifiers, peak detector, sample and hold circuit, log and antilog amplifiers, analog multipliers and dividers, comparators, window detector, Schmitt trigger, square wave, triangular wave generators and pulse generator, Timer: Introduction, pin details of 555 I.C., functional diagram of 555 IC, Multi-vibrators, linear ramp generator and FSK generator, Data converters: Principles of digital to analog converter (DAC) and analog to digital converters (ADC), specifications of ADC and DAC, Regulated power supplies using IC's: Analysis and design of linear series voltage regulators using 78XX and 79XX series, LM317. Current Feedback Op-Amp

## **D. TEXT BOOKS:**

1. Stanley William, *Operational Amplifiers with Linear Integrated Circuits*, Prentice Hall 2004.
2. Ramakant A. Gayakwad, *Op-Amps and Linear Integrated Circuits*, 4<sup>th</sup> edition, Prentice Hall of India.

## **E. REFERENCE BOOKS:**

1. Milman Jacob, *Microelectronics*, McGraw Hill, 1979.
  2. Franco Sergio, *Design with Op amps & Analog Integrated Circuits*, Tata McGraw Hill, 1997.
  3. D. L. Terrell, Butterworth, Heinemann, *Op Amps Design, Application, and Troubleshooting*, Elsevier Publications, 1996.
  4. D. Roy Choudhury., Shail B. Jain, *Linear Integrated Circuits*, 4<sup>th</sup> edition, New Age International Publication, 2010.
  5. Anand Kumar, *Fundamental of digital circuits*, Prentice Hall of India, 2001.
  6. R. L. Boylestad & L. Nashelsky, *Electronic Devices and Circuit Theory*, 8<sup>th</sup> edition, PHI Learning publications, 2003.
- NPTEL >> Electronics & Communication Engineering >> Analog Circuits (Web)

**F. Lecture Plan:**

Lecture S.no.	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
L1	<b>Introduction</b> , Basics Of Analog System Design	<b>NA</b>	Lecture	<b>NA</b>	<b>NA</b>
L2	Review Of Concepts - Amplifier Basics	To learn the basics of operational amplifier IC, understand the working principle and pin diagram of IC741	Lecture	CO.1, CO.4	In class quiz
L3	Review Of Op-Amp Basics, Internal Block Diagram		Lecture	CO.1, CO.4	In class quiz
L4	Internal Block Diagram and Characteristics Of Ideal Op-Amp		Lecture	CO.1, CO.4	Sessional Exam
L5	Characteristics Of Ideal Operational Amplifier And Signal Analysis		Lecture	CO.1, CO.4	End semester exam
L6	Frequency Response Analysis - Introduction		Lecture, Presentation	CO.1, CO.4	End semester exam
L7	Frequency Response Analysis Of Op-Amp	Learn the frequency properties of op-amp	Lecture, presentation	CO.4	Home assignment
L8	Numerical Questions Practice		Class activity	CO.4	End semester exam
L9	Linear Applications Of Op-Amp - Introduction	Implement the op-amps in various practical applications and learn their uses.	Lecture	CO.4	Sessional Exam
L10	Linear Applications Of Op-Amp - Open Loop And Closed Loop Operation Of Operational Amplifier		Lecture, presentation	CO.1	Sessional Exam
L11	Inverting Amplifier, Non-Inverting Amplifier		Lecture	CO.1	In class quiz
L12	Different Configurations Of Op-Amp		Lecture, presentation	CO.1	In class quiz
L13	Different Configurations Of Op-Amp		Presentation	CO.2, CO.4	End semester exam
L14	Numerical questions practice		Class activity	CO.2, CO.4	Sessional Exam
L15	<b>Non-Linear Applications Of Operational Amplifier</b> - Introduction	Explore the different non-linear applications of op-amp and their implementation  Design op-amp circuits for non-linear applications	Lecture, presentation	CO.2, CO.1	In class quiz
L16	Precision Half Wave And Full Wave Rectifiers		Lecture, presentation	CO.2, CO.1	Home assignment
L17	Peak Detector, Sample And Hold Circuit		Presentation	CO.2, CO.1	Home assignment
L18	Sample And Hold Circuit, Log And Antilog Amplifiers		Presentation	CO.2, CO.1	In class quiz

L19	Log And Antilog Amplifiers, Analog Multipliers And Dividers		Presentation	CO.1	In class quiz
L20	Non-Linear Applications – Comparators, Window Detector		Lecture, Class activity	CO.1	In class quiz
L21	Non-Linear Applications - Schmitt Trigger		Lecture, Class activity	CO.1	Sessional exam
L22	Schmitt Trigger and Square Wave		Lecture, presentation	CO.1	Sessional exam
L23	Triangular Wave And Pulse Generators		Lecture	CO.4	Sessional exam
L24	Numerical Questions Practice		Class activity	CO.4	Sessional exam
L25	<b>Filter Design:</b> Introduction And Basics Of Passive Filters	Learn about different practical filters, implementation and practical uses  Apply the knowledge in practical filter circuit implementation	Lecture	CO.4	In class quiz
L26	Active Filters – Introduction, Design And Analysis Of First Order Low Pass Filter		Lecture, presentation	CO.4	In class quiz
L27	Active Filters –Design And Analysis Of First And Higher Order Low And High Pass Filters		Lecture, presentation	CO.4	Lab implementation
L28	Design And Analysis Of Band Pass Filters		Flipped classroom	CO.1, CO.3	Lab implementation
L29	Band Elimination And All Pass Active Filters		Flipped classroom	CO.1, CO.3	Lab implementation
L30	Numerical Problems		Class activity	CO.1, CO.3	In class quiz
L31	Numerical Problems		Class activity	CO.1, CO.3	In class quiz
L32	<b>Timer:</b> Introduction	Learn about pulse width modulation (PWM) in practical applications and implementation using 555 timer IC  Design PWM circuits using 555 timer IC	Lecture	CO.5	End Semester exam
L33	Basics Of Multivibrator and Theory		Lecture, flipped classroom	CO.5	End Semester exam
L34	555 IC Timer - Introduction		Lecture	CO.5	End Semester exam
L35	555 IC Timer - Pin Details Of 555 I.C., Functional Diagram Of 555 IC		presentation	CO.5	In class quiz
L36	Working of 555 Timer		Presentation	CO.5	In class quiz
L37	Different modes of 555 Timer		Lecture, presentation	CO.5	Lab implementation
L38	Numerical Practice		Class activity	CO.4, CO.5	Sessional exam
L39	<b>Data Converters:</b> Principles Of ADC And DAC	Fundamental understanding of data converters and uses	Lecture	CO.2	End Semester exam

L40	ADC/DAC – Specifications and Configuration		Presentation	CO.2	
L41	DAC – Different types and principle		Lecture	CO.2	End Semester exam
L42	ADC – Different types and principle		Class activity	CO.2	End Semester exam
L43	ADC – Different types and principle		Class activity	CO.2	Class test
L44	Voltage Controlled Oscillator (VCO)		Lecture	CO.2	
L45	Voltage Controlled Oscillator (VCO)		Class activity	CO.2	
L46	Numerical Questions Practice		Class activity	CO.2	
L47	Voltage regulation using Zener diode	Students will learn how to make power supplies using different ICs	Presentation	CO.3	Student presentation
L48	<b>Regulated Power Supplies</b> Using IC's		Presentation	CO.3	Student presentation
L49	Analysis And Design Of Linear Series Voltage Regulators Using 78XX And 79XX Series		Presentation	CO.3	Student presentation
L50	Circuit Diagram and Analysis of Lm317		Presentation	CO.3	Student presentation

**G. Course Articulation Matrix: (Mapping of COs with POs)**

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MC1308.1	Elucidate and design the linear and non-linear applications of an op-amp and special application IC's.	3	1		1								1	1	3	
MC1308.2	Classify and comprehend the working principle of data converters.	3	1	2										1	3	
MC1308.3	Illustrate the function of application specific ICs such as Voltage regulators, PLL and its application.	3		2	2										3	
MC1308.4	Infer the DC and AC characteristics of operational amplifiers and its effect on output and their compensation techniques.	3	2		2									1	3	
MC1308.5	Explain and compare the working of multivibrator using special application IC 555 and general purpose op-amp.	3		2	1	2								1	3	

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**



**MANIPAL UNIVERSITY JAIPUR**  
School of Automobile Mechanical and Mechatronics Engineering  
Department of Mechatronics Engineering  
Course Hand-out

Theory of Machines | MC1309 | 4 Credits | 4 0 0 4

Session: July 19 – Nov 19 | Faculty: Mohit Jain | Class: Departmental Core

**A. INTRODUCTION:** This course is offered by Dept. of Mechatronics Engineering as a core course. This course is designed to give a clear understanding of the concepts underlying the engineering design. Simple mathematical methods are preferred to design a mechanical mechanism.

**B. COURSE OUTCOMES:** At the end of the course, students will be able to

**CO.1 [MC1309.1]** Outline the basics of mechanisms and machines like degree of freedom along with type of mechanisms and their equivalent mechanisms.

**CO.2 [MC1309.2]** Study of velocity analysis – linear velocities of various points on different links of a mechanism as well as the angular velocities of the links.

**CO.3 [MC1309.3]** Study of acceleration analysis – linear acceleration of various links of a mechanism as well as the angular acceleration of the links which further leads to force analysis of various links of a mechanism.

**CO.4 [MC1309.4]** To analyse a gear design and gear train. To calculate speed of various gears in gear train and in differential gears.

**CO.5 [MC1309.5]** To synthesis a mechanical mechanism as per the required motion to enhance employability skills and to understand the concepts of Gyroscope.

**C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES**

**[PO.1]. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

**[PO.2]. Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

**[PO.3]. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

**[PO.4]. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

**[PO.5]. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

**[PO.6]. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

**[PO.7]. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

**[PO.8]. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices

**[PO.9]. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

**[PO.10]. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

**[PO.11] Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

**[PO.12]. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

**[PSO.1].** Apply the knowledge of basic sciences, analytical skills and modern computing tools to design, perform and analyse experiments to meet desired goals within the given constraints.

**[PSO.2].** Apply concepts of circuit analysis, analog and digital electronics, controls, electric drives, instrumentation, power systems, machine learning and artificial intelligence to design and automation of mechatronics systems.

**[PSO.3].** Use the principles of solid mechanics, fluid mechanics, strength of materials, advanced functional materials and manufacturing processes to design, manufacture, and commissioning of mechatronics systems.

**D. Assessment Plan:**

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	15
	Sessional Exam II (Closed Book)	15
	Quizzes and Assignments	30
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity classroom participation by a student will be assessed and marks will be awarded.	

## E. SYLLABUS:

**Basic Concepts:** Mechanism and machine, kinematic pair, link, chain and inversions, constrained and unconstrained motions, four bar mechanism, single and double slider crank mechanisms with inversions, quick return mechanism, toggle mechanism, Hooke's coupling. **Velocity and Acceleration:** Solution of simple mechanisms by relative velocity and acceleration method, **Cams:** Types of cams, Types of followers, Cam profiles, Graphical methods for simple harmonic motion, Uniform velocity and cycloidal motion, Radial and oscillating follower, Calculation of maximum velocity and acceleration of follower, **Gears:** Classifications, Law of gearing, Spur gear definitions, Involute tooth profile and involutometry, Determination of length of path of contact, Arc of contact, Contact ratio, Interference in involute gear, Minimum number of teeth on pinion to avoid interference, Parallel and crossed helical gear, **Gear trains:** Simple, compound, reverted and epicyclic gear train, Solution by tabular column method only, Torque transmitted by epicyclic gear train, Bevel epicyclic gear train, Differential gear drive of an automobile, **Static and dynamic balancing:** Balancing of revolving masses in single plane and different planes (Graphical method). Balancing of in-line and V-Engine, **Governors:** Characteristics of governors, Porter and proell governor, Hartnell governor, **Gyroscope:** Gyroscopic couple of a spinning disc. Condition for stability of a four wheeler and two wheeler.

## F. Text Books

T1. Theory of Machines, S.S.Rattan,, McGrawHill

T2. Theory of Machines and Mechanisms, Joseph E. Shigley, Oxford University Press

## G. Reference Books

R1. Kinematics and Dynamics of Machinery, R L Norton, McGrawHill

R2. Machines and Mechanisms Applied Kinematic Analysis, David H. Myszka, Pearson

**H. Lecture Plan:**

Lec. No	Topics	Session Objective	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1-3	Introduction and Course Hand-out briefing	To acquaint and clear teachers expectations and understand student expectations	Lecture	CO.1	NA
4-7	Introduction to degree of mechanisms	To understand the importance of mechanisms	Lecture	CO.1	
8-11	Equivalent mechanisms and type of mechanisms	Application of mechanisms in different machines	Lecture	CO.1	Home Assignment
12-15	Introduction to velocity analysis of kinematic mechanisms	Need to know to reason behind calculating the velocity of links	Lecture	CO.2	
16-18	To calculate velocity of various points of links in mechanisms	To how to calculate velocity in any mechanism	Lecture	CO.2	Home Assignment, Quiz
19-22	Introduction to acceleration analysis of kinematic mechanisms	Need to know to reason behind calculating the acceleration of links	Lecture	CO.3	
23-25	To calculate acceleration of various points of links in mechanisms	To how to calculate acceleration in any mechanism	Lecture	CO.3	Quiz
26-27	Introduction to gears and gear trains	To learn basics of gear design	Lecture	CO.4	
28-30	Calculation of gear trains	To calculate speed of gears in gear train	Lecture	CO.4	Home Assignment
31-32	Introduction to Synthesis	To learn the basics to how to design a mechanism	Lecture	CO.5	
33-37	Function generation and path generation and for finitely separated positions of a rigid body.	To learn how to make dimensional synthesis as per the required path	Lecture	CO.5	
38-41	Synthesis of mechanisms	Design a linkage as per required path and motion	Lecture	CO.5	Home Assignment, Quiz
42-44	Introduction to Gyroscope	Impact of gyroscope and its importance	Lecture	CO.5	
45-48	Gyroscopic effects in aeroplanes, ships, car and bicycle.	To consider the impact of gyroscope in design analysis	Lecture	CO.5	Home Assignment, Quiz

# I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELTION WITH PROGRAM OUTCOMES											CORRELATION WITH PROGRAM SPECIFIC OUTCOMES			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MC 1309.1	Outline the basics of mechanisms and machines like degree of freedom along with type of mechanisms and their equivalent mechanisms	3	1											2		
MC 1309.2	Study of velocity analysis – linear velocities of various points on different links of a mechanism as well as the angular velocities of the links	3	2											2		
MC 1309.3	Study of acceleration analysis – linear acceleration of various links of a mechanism as well as the angular acceleration of the links which further leads to force analysis of various links of a mechanism	3	3	1										3		
MC 1309.4	To analyse a gear design and gear train. To calculate speed of various gears in gear train and in differential gears	2	3		1									3		
MC 1309.5	To synthesis a mechanical mechanism as per the required motion and to understand the concepts of Gyroscope		1	2	3									3		2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation



**MANIPAL UNIVERSITY JAIPUR**  
School of Automobile Mechanical and Mechatronics Engineering  
Department of Mechatronics Engineering  
Course Hand-out

Control Systems | MC1507 | 4 Credits | 4 0 0 4

Session: July 19 – Nov19 | Faculty: Dr. Ajay Kumar| Class: Core Subject

**A. INTRODUCTION:** This course is offered by Dept. of Mechatronics Engineering as a Program Elective. This course covers the analysis of linear systems and its stability using various techniques.

**B. COURSE OUTCOMES:** At the end of the course, students will be able to

[ME1507.1] Describe the mathematical model of a system and understand the methods of representation of systems and to design their transfer function models.

[MC1507.2] Translate the Mechanical System to analogous Electrical System.

[MC1507.3] Describe feedback control in control systems.

[MC1507.4] Analyze the time response of systems and steady state error analysis and Interpret and differentiate the response of the different order systems for standard test input signals.

[MC1507.5] Demonstrate the methods of basic control system design, including time and frequency response. Analyze and test MATLAB programs to check the system stability to enhance employability skills

**C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES**

[PO.1].**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an Engineering specialization to the solution of complex engineering problems.

[PO.2].**Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching

Substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

[PO.3].**Design/development of solutions:** Design solutions for complex engineering problems and design system Components or processes that meet the specified needs with appropriate consideration for the public health and

Safety, and the cultural, societal, and environmental considerations.

[PO.4].**Conduct investigations of complex problems:** Use research-based knowledge and research methods including

Design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid Conclusions.

[PO.5]. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the Limitations.

[PO.6].**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, Safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering Practice

- [PO.7]. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
- [PO.8]. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the Engineering practices
- [PO.9]. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
- [PO.10]. Communication:** Communicate effectively on complex engineering activities with the engineering Community and with society at large, such as, being able to comprehend and write effective reports and design Documentation, make effective presentations, and give and receive clear instructions
- [PO.11] Project management and finance:** Demonstrate knowledge and understanding of the engineering and Management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments
- [PO.12]. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
- [PSO.1].** Apply the knowledge of basic sciences, analytical skills and modern computing tools to design, perform and analyze experiments to meet desired goals within the given constraints.
- [PSO.2].** Apply concepts of circuit analysis, analog and digital electronics, controls, electric drives, instrumentation, Power systems, machine learning and artificial intelligence to design and automation of mechatronics systems. **[PSO.3].** Use the principles of solid mechanics, fluid mechanics, strength of materials, advanced functional materials and manufacturing processes to design, manufacture, and commissioning of mechatronics systems.

**D. Assessment Rubrics:**

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	15
	Sessional Exam II (Closed Book)	15
	In class Quizzes and Assignment on MATLAB for designing any system	25
	Attendance	5
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity classroom participation by a student will be assessed and marks will be awarded.	

**E. SYLLABUS:**

Block Diagrams and Signal flow graph: Transfer function, Block Diagram, Simplification of systems, Signal flow graphs, Gain formula, State diagram, Transfer function of discrete data systems (PTF), Zero order hold; System modeling: Modeling of electrical and Mechanical Systems (translational & Rotational), System equations, its electrical equivalent (analogous) networks; Time domain analysis: Stability, Routh-Hurwitz criterion, time response for Continuous data systems, type and order of systems, Steady state error for linear Systems, Unit step response for second order systems, Root locus properties and construction; Frequency domain analysis: Introduction, second order prototype system, Bode diagram, Gain and Phase margins, Nyquist stability criterion; Compensators and controllers: Proportional, Integral, PI, PD and PID controllers, Lead, Lag and Lead-Lag compensators; State space representation: Stability Analysis, State transition matrix, Eigen values, Controllability and Observability.

**F. Text Books:**

Ogata, K., Modern Control Engineering, Prentice-Hall, [2002]

Hsu, J. C. & A. U. Meyer, Modern Control Principles and Applications, McGraw-Hill, [1968]

**G. Secondary References:**

Gopal, M., Modern Control System Theory, John Wiley Eastern Ltd. New Delhi, [1984]

Friedland, B., Control System Design, McGraw-Hill, [1986]

M.Gopal, "Digital Control and State Variable Methods", Tata McGraw Hill New Delhi, 2005

Kuo, B.C., "Digital Control Systems", Oxford University press, 1992.

Ogata, K., State Space Analysis of Control Systems, Prentice-Hall, [1967]

Kuo, B. C., Automatic Control Systems, Prentice-Hall, [1987]

Slotine, J. E. & Weiping Li, Applied Nonlinear Control, Prentice-Hall, [1991]

Gibson, J. E., Nonlinear Automatic Control, McGraw-Hill, [1963]

**Software:**

MATLAB: Control and Simulink Tool Boxes, Math Works Inc.

**H. Lecture Plan:**

Lec. No	Topics	Session Objective	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction and Course Hand-out briefing	To acquaint and clear teachers expectations and understand student expectations	Lecture	NA	NA
2	Introduction to feedback control system	To understand the importance of feedback systems	Lecture	CO.1 & CO.2	In Class Quiz ( Not Accounted)
3,4	Describe open loop and closed loop systems with examples	Few definitions for understanding closed loop systems	Lecture	CO.1 & CO.2	In Class Quiz
5,6	Introduction to block diagram representation	Physical meaning of the terms and its usage	Lecture	CO.2	Home Assignment
7-10	Block Diagram Representation numerical Practice	To practice numerical on Block Diagram Representation	Lecture, Flipped Classroom	CO.3	In Class Quiz
11	Concepts of Signal Flow Graph	Study of Mason Gain Formula for closed loop systems		CO.3	Home Assignment Class Quiz
12-14	Modelling of Electrical, Mechanical Systems	Study of Modelling of a system	Lecture	CO.3	Class Quiz
15,16	Numerical Practice	Numerical Practice	Lecture	CO.3	Class Quiz
17	Introduction to Control System using MATLAB	Acquaint students with the brief overview of control system toolbox	Software Learning	CO.6	Class Quiz
18-19	Introduction to stability	To check for stability conditions by and analysing in MATLAB	Software Learning	CO.6	Class Quiz, Case Study
20	Different methods for finding stability	Acquaint students about different methods for finding stability	Flipped Classroom	CO.5	Class Quiz
21	Routh Hurwitz Criteria, Numerical Practice	Acquaint students about different methods for finding stability	Lecture	CO.5	Class Quiz
22-24	Time response Analysis	Time Response for continuous Systems	Lecture	CO.5	Class Quiz
25	Numerical Practice	Numerical Practice	Lecture	CO.5	Class Quiz
26	Bode Plot	Acquaint about another method for finding stability	Lecture	CO.5	Class Quiz
27-30	Root Locus and Bode plot Numerical	Stability analysis	Lecture	CO.5	Class Quiz

	Practice				
31-32	Nyquist Criteria	Stability analysis	Lecture	CO.4	Home Assignment
33-35	Introduction to State space Analysis	To understand importance of state space analysis	Lecture	CO.4	Class Quiz
36	Introduction to PID Controller	Introduction about Controllers	Lecture	CO.3	Class Quiz
37	Revision	NA	NA, Flipped Classroom	NA	NA

# I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELTION WITH PROGRAM OUTCOMES						CORRELATION WITH PROGRAM SPECIFIC OUTCOMES								
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME 1660.1	Describe the mathematical model of a system and understand the methods of representation of system and to design their transfer function models	3	2			2								3	2	
ME16 60.2	Translate the Mechanical System to analogous Electrical System				2	3								2		
ME16 60.3	Describe feedback control in control systems.	1		3	3	2								2	3	
ME 1660.4	Analyze the time response of systems and steady state error analysis and Interpret and differentiate the response of the different order systems for standard test input signals.	2	2	2		3								2	1	
ME 1660.5	Demonstrate the methods of basic control system design, including time and frequency response. Analyze and test MATLAB programs to check the system stability.	3	1	1	2	3								3	2	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation



# MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Mechatronics Engineering

Course Hand-out

Mechatronics Systems Elements | MC 1508 | 4 Credits | 3 | 0 | 4

Session: July 19 – Nov 19 | Faculty: Ashok Kumawat | Class: Core Subject

**A. Introduction:** This course is offered by Department of Mechatronics Engineering as a core subject, targeting students who wish to pursue research & development in industries or higher studies in field of Mechatronics. The course focuses on key elements of mechatronics system such as system modelling, sensors, actuators and control algorithms.

## B. Course Objectives:

[1508.1]. Discuss the basic elements of a mechatronics system.

[1508.2]. Analyse different type of actuators such as relays, motors and their applications and hence develop employability skills.

[1508.3]. Understand the working and application of various sensors.

[1508.4]. Design various type of signal conditioning systems for a mechatronics system.

[1508.5]. Design and implementation of a control algorithm in a mechatronics system.

## C. Program Outcomes and Program Specific Outcomes

[PO.1]. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

[PO.2]. **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

[PO.3]. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health

and safety, and the cultural, societal, and environmental considerations

[PO.4]. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

[PO.5]. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

[PO.6]. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal,

health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

[PO.7]. **Environment and sustainability:** Understand the impact of the professional engineering solutions in

societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

[PO.8]. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the

engineering practices

**[PO.9]. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse

teams, and in multidisciplinary settings

**[PO.10]. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

**[PO.11]. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects

and in multidisciplinary environments

**[PO.12]. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

**[PSO.1].** Apply the knowledge of basic sciences, analytical skills and modern computing tools to design, perform and analyze experiments to meet desired goals within the given constraints.

**[PSO.2].** Apply concepts of circuit analysis, analog and digital electronics, controls, electric drives, instrumentation, power systems, machine learning and artificial intelligence to design and automation of mechatronics systems.

**[PSO.3].** Use the principles of solid mechanics, fluid mechanics, strength of materials, advanced functional materials and manufacturing processes to design, manufacture, and commissioning of mechatronics systems.

#### D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I	15
	Sessional Exam II	15
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

## E. Syllabus

**Introduction** of mechatronic systems, needs and benefits of mechatronics in manufacturing, **Sensors and Transducers:** Displacement Sensor Strain - Strain gauges, Force/Torque, Motion & Velocity sensors, Proximity and Range sensors – Eddy current sensor, ultrasonic sensor, laser interferometer transducer, Hall Effect sensor, inductive proximity switch, Light sensors, phototransistors, Flow sensors, laser Doppler anemometer, tactile sensors, micro-switch & reed switch, Piezoelectric sensors, vision sensor, **Drives and Actuators:** Solenoids, relays, diodes, Thyristors, TRIACS, BJT, FET, DC motor, Servo motor, BLDC Motor, AC Motor, stepper motors, Piezoelectric actuators, Shape memory alloys, Hydraulic & Pneumatic devices, Power supplies, valves, cylinder sequencing, **Data Acquisition & Translation:** Signal conditioning, Multiplexer, Pulse width Modulation, Signal Analysis, Linearization of data, Compensation, Signal Averaging, Fourier analysis, **Data Presentation System:** Display - Cathode ray oscilloscope, LED, LCD, Printers, Magnetic Recording. **Controllers and Algorithms:** PID controller and controller tuning.

## F. Text Books

T1. D. A. Bradley and others, Mechatronics, Chapman & Hall Publications.

T2. David G. Alciatore & Michael B Hstand., Introduction to Mechatronics and Measurement systems, Tata McGraw Hill, 2003.

## Reference Books

R1. Dan Nesculescu, Mechatronics, Pearson Education Pvt. Ltd, 2002

R2. C. R. Venkataramana, Mechatronics, Sapna Book house, Bangalore, 2001

**G. Lecture Plan:**

Lecture No.	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1,2	Introduction, Basic elements of MSE	To understand the basic elements of MSE	Lecture	1508.1	In Class Quiz Mid Term I End Term
3,4	Basics of Sensors and Transducers, Displacement Sensors	Understanding basics of sensors and working of displacement sensor	Lecture	1508.1 1508.3	In Class Quiz Mid Term I
5	Strain gauges	Analysis and application of strain gauge sensor	Lecture	1508.3	In Class Quiz End Term
6,7	Force/Torque measurement	Measurement methods of force/torque	Lecture	1508.3	Home Assignment End Term
8,9,10	Motion & Velocity sensors	Explain working of motion and velocity sensors	Lecture	1508.3	In Class Quiz End Term
11,12,13	Proximity and Range sensors,	Basics of proximity sensors and working of different type of sensors	Activity (Think Pair Share)	1508.3	Class Quiz Mid Term I End Term
14,15	Eddy current sensor,	Explain working of eddy current sensor	Lecture, Activity (Jigsaw)	1508.3	Class Quiz Mid Term I End term
16	ultrasonic sensor,	Describe the working and application of ultrasonic sensor	Lecture, Flipped Class	1508.3	Home Assignment Class Quiz Mid Term I End Term
17	laser interferometer transducer	Describe the working and application of laser interferometer transducer	Lecture, Activity (Think Pair Share)	1508.3	Class Quiz Mid Term I End Term
18	Hall Effect sensor,	Discuss the working of hall effect sensor	Lecture	1508.3	Class Quiz Mid Term I End Term
19,20	Light sensors	Discuss about different type of light sensors	Lecture	1508.3	Class Quiz End Term
21,22	Flow sensors, laser Doppler anemometer	Explain about flow sensors	Lecture	1508.3	Class Quiz Mid Term II End Term
23,24	tactile sensors	Application and working of tactile sensor	Lecture, Activity	1508.3	Class Quiz Mid Term II End Term
25,26	Piezoelectric sensors,	Analysis and working of	Lecture, Activity	1508.3	Class Quiz

		piezoelectric sensor			Mid Term II End Term
27	vision sensor	Describe vision sensors	Lecture	I508.3	Class Quiz Mid Term II End Term
28,29	Relays, Solenoids,	Explain working of relays and solenoid	Lecture	I508.2 I508.1	Class Quiz Mid Term II End Term
30,31	diodes, BJT, FET, Thyristor, TRIAC	Describe the basics of solid state devices	Lecture	I508.1	Class Quiz End Term
32,33	DC motor	Explain working of dc motors	Lecture	I508.2	Class Quiz End Term
34	Servo motor	Modelling and working of servo motor	Lecture	I508.2	Class Quiz Mid Term II End Term
35	BLDC Motor	Describe working of BLDC motor	Lecture	I508.2	Class Quiz End Term
36,37	AC Motor	Explain working of AC motors	Lecture	I508.2	Class Quiz End term
38,39	stepper motors	Explain application and working of stepper motor	Lecture	I508.2	Class Quiz Mid Term II End Term
40,41	Piezoelectric actuators	Application of piezoelectric actuator	Lecture	I508.2	Class Quiz Mid Term II End Term
42	Shape memory alloys	Describe shape memory alloy	Lecture	I508.1	Class Quiz Mid Term II End Term
43,44	Hydraulic & Pneumatic devices, valves	Basics of valves	Lecture	I508.1	Class Quiz Mid Term II End Term
45	Power supplies	Basics of power supplies	Lecture	I508.1	Class Quiz
46	Basics of Signal conditioning, Current Feedback Operational amplifiers	Analysis of CFOA	Lecture	I508.4	End Term
47	Multiplexer, Pulse width Modulation	Describe PWM	Lecture	I508.4	Class Quiz
48	Signal Analysis, Linearization of data	Analysis to linearize the data	Lecture	I508.4	Class Quiz End Term
49	Compensation, Signal Averaging, Fourier analysis	Analysis of signals	Lecture	I508.4	Class Quiz
50	Data Presentation System: Display - Cathode ray oscilloscope, ,	Explanation of CRO	Lecture	I508.1 I508.5	Class Quiz Mid Term II

					End Term
51	LED, LCD Printers, Magnetic Recording	Explain the working of data presenting systems	Lecture	1508.1	Class Quiz End Term
52	PID Controller and Controller parameter tuning	Analysis and tuning of PID controller	Lecture	1508.5	Class Quiz End Term

#### H. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MC 1508.1	Discuss the basic elements of a mechatronics system.	1	1	1	1									1	1	1
MC 1508.2	Analyse different type of actuators such as relays, motors and their applications.	1	2	2	1		1							1	2	1
MC 1508.3	Understand the working and application of various sensors.	1	2	2	1		1							1	2	1
MC 1508.4	Design various type of signal conditioning systems for a mechatronics system.	1	2	2	1	1	1			1		1		1	3	1
MC 1508.5	Design and implementation of a control algorithm in a mechatronics system.	1	2	3	3	1	2	1		1		1		1	3	1

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# MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Mechatronics Engineering

Course Hand-out

Microprocessors and Microcontrollers| MC 1509 | 4 Credits | 3 | 0 | 4

Session: July 19 – Nov 19 | Faculty: Kumar Gaurav | Class: Dep. Core (V Sem)

**A. Introduction:** This course is offered by Dept. of Mechatronics Engineering as a department core, targeting students who wish to pursue research & development in industries or higher studies in field of systems built around microprocessors and microcontrollers. It is a step-by-step walk through basics and up-to design and development phase of the project based on the microprocessors and microcontrollers. Programming in assembly as well as Embedded C further add interest and strengthen the course which is of utmost need to program these processors/controllers. Microprocessors and microcontrollers are also used to control traffic lights, appliances, motion control, position control, servo control, elevators, automation, electric car and control of AC/DC machines. It is also used in measurement and display of electrical and physical quantities such as voltage, current, frequency, phase angle, stress, strain etc. In a nutshell this course will introduce the world of automated systems driven by microprocessors and microcontrollers.

**B. Course Objectives:** At the end of the course, students will be able to

- [1509.1]. Assess and solve basic binary math operations using the microprocessor and explain the microprocessor's and Microcontroller's internal architecture and its operation within the area of manufacturing and performance.
- [1509.2]. Apply knowledge and demonstrate programming proficiency using the various addressing modes and data transfer instructions of the target microprocessor and microcontroller.
- [1509.3]. Compare accepted standards and guidelines to select appropriate Microprocessor (8085 & 8086) and Microcontroller to meet specified performance requirements.
- [1509.4]. Analyse assembly language programs; select appropriate assemble into machine a cross assembler utility of a microprocessor and microcontroller.
- [1509.5]. Design electrical circuitry to the Microprocessor I/O ports in order to interface the processor to external devices.
- [1509.6]. Evaluate assembly language programs and download the machine code that will provide solutions to real-world control problems and enhance employability skills.

## C. Program Outcomes and Program Specific Outcomes

- [PO.1]. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- [PO.2]. **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
- [PO.3]. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
- [PO.4]. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
- [PO.5]. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

- [PO.6].The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice
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- [PO.11]. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments
- [PO.12]. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

**[PSO.1].** Apply the knowledge of basic sciences, analytical skills and modern computing tools to design, perform and analyze experiments to meet desired goals within the given constraints.

**[PSO.2].** Apply concepts of circuit analysis, analog and digital electronics, controls, electric drives, instrumentation, power systems, machine learning and artificial intelligence to design and automation of mechatronics systems.

**[PSO.3].** Use the principles of solid mechanics, fluid mechanics, strength of materials, advanced functional materials and manufacturing processes to design, manufacture, and commissioning of mechatronics systems.

#### D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	15
	Sessional Exam II (Close Book)	15
	In class Quizzes and Assignments , mini projects, Activity feedbacks (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam (Close Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Mini Project/Activity Assignment (Formative)	There are situations where a student may have to work in home on a given problem. However, a student is expected to participate with full zeal and perform these assignments (Individually/Team) with graded marks and show the outcome.	

## E. Syllabus

**MICROPROCESSORS AND MICROCONTROLLERS:** Introduction to microprocessor, History of Microprocessors, General block diagram of 8085, & 8086 with their instruction set. Introduction to microcontroller, History of Micro controllers, Embedded versus External memory devices, Microcontroller survey, CISC and RISC Microcontrollers, Harvard and von Neumann Architecture, Commercial Micro controller Devices, Introduction to 8051 family, History of 8051, Architectural features of 8051, Programming model. Pin details, I/O Ports, Power down operation, Addressing Mode, Instruction set of 8051 and Programming, Programming the 8051 resources, Counters, Timers, Serial Interface, Multiprocessor communication and Interrupts, Measurement of frequency, period and pulse width of a signal, Peripheral Interfacing- memory interfacing, Key board, LCD, stepper motor, Seven Segment Display, Digital to analog Converter, Analog to Digital converters, The 8051 based system design- case studies, Traffic light control, and Washing machine control, mining problem, Turbine monitor, Introduction to PIC Microcontrollers- Architectural and Peripheral features, ALU, CPU, Memory map, clock, pipelining, addressing and I/O ports.

## F. Text Books

T1. K. Kant, *Microprocessors and Micro controllers*, PHI learning publications, 2007.

T2. M. A. Mazidi, J. G. Mazidi, & R. D. Mckinlay, *8051 Microcontroller and Embedded Systems Using Assembly and C*, Pearson Education, 2010.

## G. Reference Books

R1. A.V. Deshmukh, *Micro controllers- Theory and Applications*, Tata McGraw Hill, New Delhi, 2008.

R2. J. A. Kenneth, *The 8051 Microcontroller Architecture, programming and applications*, Penram International Publications, Mumbai, 2008.

R3. *PIC micro Mid- Range MCU Family Reference Manual*.

## H. Lecture Plan:

Lec No	Topics	Session Outcome	Mode of Delivery	Corresponding CO
1	Introduction to class about course	To acquaint and clear teachers expectations and understand student expectations	Lecture	NA
2	Introduction to microprocessor, History of microprocessors	Explain need of microprocessors/microcontrollers in daily life	Lecture	1509.1
3	General block diagram of 8085 & 8086	Discussion about different components of a computing system	Lecture	1509.1
3	Addition and subtraction in different Number system	Recall basics of number system, binary, decimal, hexadecimal etc.	Lecture	1509.1
4	Difference b/w a microprocessor and microcontroller	Difference between the two	Lecture	1509.1
5,6,7	Pin Diagram of 8085 microprocessor	Details pin diagram discussion	Lecture	1509.2 1509.5
8,9,10	Internal architecture of 8085	Register array description	Lecture	1509.6
11,12	Comparison of 8085 and 8086 and introduction to assembly level language	Basics of assembly level programming	Lecture	1509.2
13,14, 15	Instruction set of 8085	Arithmetic, logical, branch instructions	Lecture	1509.2 1509.3
16,17	Assembly level Programming for 8085	Practice problems		
18	CISC and RISC Microcontrollers, Harvard and von Neumann Architecture,	Difference between the two	Lecture	1509.2 1509.3
19	Interrupts in 8085	Discussion and problems		1509.3
20	Commercial Micro controller Devices	Microcontroller, discussion	Lecture	1509.2
21,22	Introduction to 8051 family, History of 8051	Discussion about other features of 8051	Lecture	1509.4
23,24,25,26	Architectural features of 8051	Details about architectural features and their interconnect	Lecture	1509.4
27	Programming model	Register array description	Lecture	1509.4 1509.3
28,29	Pin details, I/O Ports, Power down operation	Working features	Lecture	1509.4 1509.3
30	Addressing Mode of 8051	Category of instructions	Lecture	1509.4
31,32,33	Instruction set of 8051	Assembly level opcode details	Lecture	1509.4
34,35,36	Programming in 8051	Programming practice	Lecture	1509.5
37,38	Counters	Counter importance and its programming procedure	Lecture	1509.6 1509.5

39,40	Timers	Timer importance and its programming procedure	Lecture	1509.6 1509.3
41, 42	Serial Interface	Serial communication and its programming	Lecture	1509.2 1509.1
43	Measurement of frequency, period and pulse width of a signal,	Concept of frequency and pulse width with programming	Lecture	1509.4
44,45,46	Multiprocessor communication and Interrupts,	Interrupts in 8051 microcontroller and their importance	Lecture	1509.5 1509.3
47	The 8051 based system design- case studies, and Washing machine control	Practical application	Lecture	1509.6
48	Traffic light control,	Practical application	Lecture	1509.6
49	mining problem, Turbine monitor,	Practical application	Lecture	1509.6
50	Introduction to PIC Microcontrollers-, Architectural and Peripheral features	PIC Microcontrollers	Lecture	1509.1 1509.2
51	ALU, CPU, Memory map, clock, pipelining	Their relevance in PIC Microcontrollers	Lecture	1509.1 1509.3
52	Addressing and I/O ports	Discussion in brief about addressing modes	Lecture	1509.1 1509.2
53	Revision	NA	NA	

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		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MC 1509.1	Assess and solve basic binary math operations using the microprocessor and explain the microprocessor's and Microcontroller's internal architecture and its operation within the area of manufacturing and performance	3	2							1				1	1	
MC 1509.2	Apply knowledge and demonstrate programming proficiency using the various addressing modes and data transfer instructions of the target microprocessor and microcontroller		2	1	1										2	1
MC 1509.3	Compare accepted standards and guidelines to select appropriate Microprocessor (8085 & 8086) and Microcontroller to meet specified performance requirements.					3		1	1	2	1		3	1	3	
MC 1509.4	Analyse assembly language programs; select appropriate assemble into machine a cross assembler utility of a microprocessor and microcontroller		1	2	2	1	3	1								1
MC 1509.5	Design electrical circuitry to the Microprocessor I/O ports in order to interface the processor to external devices.	1	1	3	1			2	1					3	1	1
MC 1509.6	Evaluate assembly language programs and download the machine code that will provide solutions real-world control problems.	1	1	1	1	1	1				2	1	1		1	1

I- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation



# MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Mechatronics Engineering

Course Hand-out

Signals and systems| MCI550 | 3 Credits | 3 0 0 3

Session: July 19 – Nov 19 | Faculty: Shambo Roy Chowdhury | Class: Prog. Elective (V Sem)

**A. Introduction:** Signal processing is an extremely important tool in a wide variety of engineering domains. This course is introduced in mechatronics course to provide the basic concepts and theories related to analog and digital signal processing. The course is intended to impart knowledge on signal transformation techniques and its application. The prerequisites are calculus, basics of complex numbers, and some exposure to differential equations. Prior exposure to the fundamentals of circuits for electrical engineers or fundamentals of dynamics for mechanical engineers is helpful but not essential.

**B. Course Outcomes:** At the end of the course, students will be able

[I550.1]. To classify different types of signals and perform basic time domain operations on them

[I550.2]. To perform time domain transformations and operations on various signal types

[I550.3]. To perform frequency domain transformations and operations on various signal types

[I550.4]. To implement and verify signal transformation algorithms using software tools in MATLAB and python to enhance employability skills.

[I550.5]. To interpret practical problems with knowledge of signals and systems

## C. Program Outcomes and Program Specific Outcomes

[PO.1].**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2].**Problem analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3].**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

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**[PO.12].Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

**[PSO.1].** Apply the knowledge of basic sciences, analytical skills and modern computing tools to design, perform and analyse experiments to meet desired goals within the given constraints.

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	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

#### E. Syllabus

**Introduction to signals and systems:** Definitions, Overview of specific systems, Classification of signals, Basic operations on signals, Elementary signals and functions, Systems viewed as interconnections of operations, properties of systems. Time domain representations for **linear time-invariant systems:** Introduction, Convolution: Impulse response representation for LTI systems, properties of the impulse response representation for LTI systems, Differential and difference equation representations for LTI systems, Block diagram representations. Fourier representation for signals: The **discrete-time Fourier series**, continuous-time periodic signals: The Fourier series, Discrete-time non-periodic signals: The discrete-time Fourier transform, **continuous-time non-periodic signals:** The **Fourier transform**, properties of Fourier representations, Discrete-time periodic signals, **Fast Fourier transform. Z-transform** and its applications: Review of z-transform, unilateral z-transform, solution of difference equations, Analysis of LTI system in z-domain-system function, pole-zero analysis, stability

## **F. Text Books**

T1. A.V. Oppenheim, A. S. Willsky & A. Nawab, *Signals and Systems*, 2<sup>nd</sup> edition, PHI. /Pearson Education, New Delhi, 1996.

### **Reference Books**

R1. S. Haykin & B. V. Veen, *Signals and Systems*, John Wiley & Sons, New Delhi, 2<sup>nd</sup> edition, 2002.

R2. J.G. Proakis, D.G. Manolakis, D. Mimitris, *Introduction to Digital Signal Processing*, Prentice Hall, India, 4<sup>th</sup> Edition, 2006.

R3. A.V. Oppenheim & R.W. Schaffer, *Discrete Time Signal Processing*, Pearson education, 3<sup>rd</sup> Edition, 2011.

**G. Lecture Plan:**

Lec No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction and Course Hand-out briefing	To acquaint and clear teachers expectations and understand student expectations	Lecture	NA	NA
2	Introduction to signals and systems	Basic idea of what is signals and systems	Lecture	1550.1	In Class Quiz ( Not Accounted)
3-6	Continuous and discrete time signals and their properties	Thorough concept different types of signals and properties related to that	Lecture	1550.1	In Class Quiz Sessional exam I End Term
7,8	Convolution	Understand the Mathematics and physical significance of convolution	Lecture	1550.2	Home Assignment Sessional exam I End Term
9,10	Linear time invariant systems	Understanding of properties of LTI systems	Lecture, flipped class	1550.1 ,1550.2	In Class Quiz Sessional exam II End Term
11,12,13	Continuous time fourier series	Analysis of mathematical background and application of CTFS	Lecture, Activity	1550.2, 1550.3	Class Quiz Sessional exam II End term
14,15	Continuous time fourier transform	Analysis of mathematical background and application of CTFT	Lecture, Activity	1550.2, 1550.3	Home Assignment Class Quiz Sessional exam II End Term
16,17	Discrete time fourier series	Analysis of mathematical background and application of DTFS	Lecture, Activity	1550.2, 1550.3	Class Quiz Sessional exam II End Term
18,19	Discrete time fourier transform	Analysis of mathematical background and application of DTFT	Lecture, Activity	1550.2, 1550.3	Class Quiz Sessional exam II End Term
20	Filtering	Introduction to different filtering methods	Lecture	1550.2, 1550.3	Class Quiz End Term
21-25	Software implementation	Use of MATLAB and python in signal processing	Lecture, activity	1550.4	Class Quiz End Term
26 - 28	The laplace transform	Analysis of mathematical background and application of Laplace transform	Lecture	1550.2, 1550.3	Class Quiz Mid Term II End Term
29 - 32	Z-transform	Analysis of mathematical background and application of Z-transform	Lecture	1550.2, 1550.3	Class Quiz End Term
33, 34	Pole-zero analysis	System analysis with pole and zero	Flipped class	1550.2, 1550.3	Class Quiz

		placements			End Term
35, 38	Case studies	Application of signals of systems in practical simulations	Activity	1550.4, 1550.5	Class Quiz End Term
39, 40	Case studies	Theoretical analysis of practical cases	Lecture, flipped class	1550.4, 1550.5	Class Quiz End Term

#### H. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MC 1550.1	To classify different types of signals and perform basic time domain operations on them	3				1								1	2	
MC 1550.2	To perform time domain transformations and operations on various signal types	2	3											2	2	
MC 1550.3	To perform frequency domain transformations and operations on various signal types	1	1			2								3	3	
MC 1550.4	To implement and verify signal transformation algorithms using software tools in MATLAB and python	1	2	2		3								3	3	
MC 1550.5	To interpret practical problems with knowledge of signals and systems		3	1						2		1	2	2	2	

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**



# MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Mechatronics Engineering  
Course Hand-out

Materials Science| MC 155I | 3 Credits | 3 0 0 3

Session: July 19 – Nov 19 | Faculty: Dr Prabhat Ranjan | Class: Programme Elective

**A. Introduction:** Crystal Structures, computations of packing factor of cubic and HCP structure, Solidification, nucleation and crystal growth, dendritic growth, Phases in solids, Equilibrium diagrams (only binary), construction and explanation of isomorphous and eutectic systems, equilibrium and non-equilibrium cooling, Equilibrium and non-equilibrium cooling of an alloy, Iron-Carbon systems, Heat treatment, continuous cooling curves isothermal transformation diagram, Ferrous-alloys.

**B. Course Outcomes:** At the end of the course, students will be able to

[155I.1] Understand the classification of materials

[155I.2] Understand the basic properties, characteristics and behaviour of materials

[155I.3] Calculate the stress, strain, and other engineering properties for basic engineering applications

[155I.4] Understand the appropriate engineering materials and their specific applications to enhance entrepreneur skills

[155I.5] Use binary phase diagrams to predict microstructures and to understand precipitation hardening

[155I.6] Understand how thermal treatment affect the properties of materials

## C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

**[PO.1]. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

**[PO.2]. Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

**[PO.3]. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

**[PO.4]. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

**[PO.5]. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

**[PO.6]. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

**[PO.7]. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

**[PO.8]. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

**[PO.9]. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

**[PO.10]. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

**[PO.11]. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

**[PO.12]. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

**D. Assessment Plan:**

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	15
	Sessional Exam II (Closed Book)	15
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses any quiz test will have to report to the instructor about the absence in advance. A makeup assignment will be given to the student.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

**E. SYLLABUS**

Introduction: Crystal Structures, computations of packing factor of cubic and HCP structure, co-ordination number, Miller indices, crystal imperfections-point & line defects. Solidification: degree of super cooling, homogeneous & heterogeneous nucleation. Mechanism of solidification, nucleation and crystal growth, dendritic growth, Phases in solids: Phases-Single phase and multiphase, Gibb's phase rule, Solid solutions and types, Intermediate phases, Equilibrium diagrams (only binary), construction and explanation of isomorphous and eutectic systems, equilibrium and non-equilibrium cooling, invariant reactions Lever rule and its application on isomorphous and eutectic systems, Equilibrium and non-equilibrium cooling of an alloy, congruent melting alloy phase and super lattices, Iron-Carbon systems: cooling curve for pure iron, types of Fe-C equilibrium diagrams, study of iron-carbon system in detail with emphasis on the invariant reactions, Heat treatment: Principle heat treatments, isothermal transformation diagram- Construction and explanation, factors affecting shape and position of isothermal transformation diagram, continuous cooling curves isothermal transformation diagram, processes like annealing, normalizing, hardening, tempering and case hardening with heat treatment cycle, Jominy hardness test, Ferrous-alloys: Composition, properties and applications of alloy steels.

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### **TEXT BOOKS**

1. W. D. Callister, Jr., Material Science and Engineering: An Introduction, 9<sup>th</sup> Edition, Wiley, 2014
2. V. Raghavan, Material Science and Engineering, 5<sup>th</sup> Edition, Prentice Hall of India, 2004

### **F. REFERENCE BOOKS**

1. Brian S Mitchell, *An Introduction to Materials Engineering and Science*, Wiley, 2003

## I. Lecture Plan:

LEC NO	TOPICS	Session Outcomes	Mode of Delivery	Corresponding CO	Assessment Mode
1	Introduction and Course Hand-out briefing	To acquaint and clear teachers expectations and understand student expectations	Lecture	NA	NA
2	Why study material science and engineering	Scope of material science and their technological applications	Lecture	1551.1	Quiz
3,4	Classification of materials, engineering needs of materials	Scope and uses	Lecture	1551.1	Quiz Mid term I
5,6	<b>Crystalline and Non-crystalline</b>	Crystalline and Non-crystalline	Lecture	1551.1	Mid term I
7,8	Lattice Points, Space Lattice and Crystal Structures	Crystal Structures	Lecture	1551.2	Mid term I Quiz
9	<b>Unit cell, Packing order of cubic and HCP</b>	<b>Packing efficiency</b>	<b>Lecture</b>	<b>1551.2</b>	Mid term I
10	Miller Indices, Crystal Imperfections,	Imperfections	Lecture	<b>1551.2</b>	Quiz End term
11	Point & Line defect	Defect	Lecture	<b>1551.2</b>	Mid term I End term
12	Solidification, Degree of super cooling	Solidification	Lecture	<b>1551.2</b> <b>1551.3</b>	Mid term I
13	Homogeneous and Heterogeneous nucleation, Mechanism of Solidification	Solidification	Lecture	<b>1551.2</b> <b>1551.3</b>	Mid term I End term
14	<b>Nucleation and crystal growth</b>	<b>Nucleation</b>	<b>Lecture</b>	<b>1551.2</b> <b>1551.3</b>	Mid term I End term
15,16	Phases in solids, single phase and multiphase, Gibb's phase rule,	Phases	Lecture	<b>1551.4</b> <b>1551.5</b>	Mid term I End term
17	<b>Solid solution and types, Intermediate phase,</b>	<b>Phases</b>	<b>Lecture</b>	<b>1551.5</b>	<b>Mid term II</b> <b>End term</b>
18	Equilibrium diagram- for binary	Optimality principle	Lecture	<b>1551.3</b> <b>1551.4</b>	Quiz End term
19	construction and explanation of isomorphous and eutectic systems,	Isomorphous and Eutectic System	Lecture	<b>1551.4</b>	Mid term II
20	Non-equilibrium cooling of an alloy	Alloy	Lecture	<b>1551.3</b> <b>1551.4</b>	Quiz
21	Congruent melting alloy phase & super lattice	<b>Supper lattice</b>	<b>Lecture</b>	<b>1551.3</b> <b>1551.4</b>	<b>Quiz</b> Mid term II
22	Iron-Carbon system	Iron-Carbon system	Lecture	<b>1551.4</b> <b>1551.5</b>	Quiz Mid term II End term
23	Iron-Carbon system	Iron-Carbon system	Lecture	<b>1551.4</b> <b>1551.5</b>	Quiz Mid term II End term
24	Cooling curve for iron	<b>Cooling curve</b>	<b>Lecture</b>	<b>1551.6</b>	<b>Mid term II</b>
25	Heat Treatment	Heat treatment	Lecture	<b>1551.6</b>	End Term
26	Isothermal transformations	Isothermal	Lecture	<b>1551.5</b> <b>1551.6</b>	Mid term II End term
27	Annealing	Annealing	Lecture	<b>1551.5</b> <b>1551.6</b>	End term

28,29	Annealing	Annealing	Lecture	<b>1551.5</b> <b>1551.6</b>	End term
30,31	Normalizing annealing	Annealing	Lecture	<b>1551.5</b> <b>1551.6</b>	Mid term II End term
32,33	Ferrous-Alloy	Alloy	Lecture	1551.3 1551.4	Mid term II End term
34,35	Ferrous-Alloy	Alloy	Lecture	1551.3 1551.4	Mid term II End term
36, 37	<b>Composition</b>	<b>Alloy composition</b>	<b>Lecture</b>	1551.3 1551.4	<b>End term</b>
38	<b>Composition</b>	<b>Alloy composition</b>	<b>Lecture</b>	1551.3 1551.4	<b>End term</b>
39	Properties and applications of alloy	Alloy	Lecture	1551.3 1551.4	End term
40	Properties and applications of alloy	Alloy	Lecture	1551.3 1551.4	End term

## 2. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MC 1551.1	Understand the classification of materials	1							2							
MC 1551.2	Understand the basic properties, characteristics and behaviour of materials			2											1	
MC 1551.3	calculate the stress, strain, and other engineering properties for basic engineering applications					2								2		
MC 1551.4	Use binary phase diagrams to predict microstructures and to understand precipitation hardening			2			1				1					
MC 1551.5	Use binary phase diagrams to predict microstructures and to understand precipitation hardening	1													1	
MC 1551.6	Understand how thermal treatment affect the properties of materials		2		1			1								

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation



# MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Mechatronics Engineering  
Course Hand-out

Manufacturing Process| MCI552 | 3 Credits | 3 0 0 3

Session: July 19 – Nov 19 | Faculty: Dr. Manish Rawat | Class: Prog. Elective

**A. Introduction:** This course is offered by Dept. of Mechatronics Engineering as a Prog. Elective, targeting students who wish to pursue research & development in industries or higher studies in field of smart machining. Manufacturing involves the transformation of raw materials from their initial form into finished, functional products. Man achieves this transformation by numerous methods utilising a variety of processes each designed to perform a specific function in the transformation process. Inherent in the design and operation of processes must be a knowledge of the properties of engineering materials and specific methods to utilise these properties during the various stages of the manufacturing process. Because of the competitive nature of the manufacturing industry, engineers are constantly striving to create new materials, better transformation methods and processes which are cheap to operate, efficient, fast and accurate. This course provides an introductory study of manufacturing processes and is complemented by further studies at higher levels of the program. Various material forming and cutting processes are considered, and theoretical knowledge is reinforced by practical demonstrations and videos.

**B. Course Objectives:** At the end of the course, students will be able to

- [I552.1] Examine the principles associated with basic operations involving the casting, machining and welding of engineering materials.
- [I552.2] Interpret the advantages and limitations of each process and its influence on the properties of the material in the finished component;
- [I552.3] Interpret the geometry of tooling used on various metal cutting machines;
- [I552.4] Skill development to analyse the practical applications of a variety of forming and machining processes
- [I552.5] Analyse the effects of heat, lubrication and various cutting tool materials on the metal cutting process.

## C. Program Outcomes and Program Specific Outcomes

- [PO.1] **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- [PO.2] **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
- [PO.3] **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
- [PO.4] **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- [PO.5] **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- [PO.6] **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

- [PO.7] Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
- [PO.8] Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices
- [PO.9] Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
- [PO.10] Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
- [PO.11] Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments
- [PO.12] Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

**[PSO.1].** Apply the knowledge of basic sciences, analytical skills and modern computing tools to design, perform and analyse experiments to meet desired goals within the given constraints.

**[PSO.2].** Apply concepts of circuit analysis, analog and digital electronics, controls, electric drives, instrumentation, power systems, machine learning and artificial intelligence to design and automation of mechatronics systems.

**[PSO.3].** Use the principles of solid mechanics, fluid mechanics, strength of materials, advanced functional materials and manufacturing processes to design, manufacture, and commissioning of mechatronics systems.

#### D. Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	15
	Sessional Exam II (Closed Book)	15
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam (Open Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

## **E. Syllabus**

Metal Casting Process: Classification of metal casting, Pattern Allowances, Molding Materials, Gating system design. Casting defects: Causes and remedies, Inspection of castings Introduction to Machine Tools: Classification of machine tool, Mechanics of Metal Cutting: Principles of metal machining, cutting tools and tool materials, tool signature, mechanics of chip removal, tool wear, tool life, economics of machining. Metal Joining Processes: Principle of welding, soldering, Brazing and adhesive bonding. Classification of welding and allied processes. Resistance welding: Spot, Projection and seam welding process, Atomic hydrogen, ultrasonic, Plasma and laser beam welding, Electron beam welding, and special welding processes e.g. TIG, MIG, friction and explosive welding. Metal Shaping and Forming: Metal working, Elastic and plastic deformation, Hot and cold working, Rolling, Principle and operations, Forging, Forging operations, extrusion, Wire and tube drawing processes. Forging: Principle of forging tool design, Cold working processes: Shearing, Drawing Squeezing, Blanking, Piercing, deep drawing, Coining and embossing.

## **F. Text Books**

- T1. S. Kalpakjian, and S. R. Schmid, Manufacturing Engineering and Technology, Pearson Education, 6th Edition, 2009.
- T2. A. Ghosh, and A. K. Malik, Manufacturing Science, Affiliated East West Press Pvt. Ltd., 2nd Edition, 2010.

## **G. Reference Books**

- R1. P.C. Sharma, A text book of Production Technology. S. Chand and Company, 4th Edition, 2006.
- R2. P. N. Rao, Manufacturing Technology Volume-I and II, Tata McGraw-Hill Education, 4th Edition, 2013.

## H. Lecture Plan:

Lec No	Topics	Session Objective	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction	Examine the principles associated with basic operations involving the casting, machining and welding of engineering materials.	Lecture	CO.I	NA
2	Metal Casting Process: An Introduction	Examine the principles associated with basic operations involving the casting, machining and welding of engineering materials.	Flipped Classroom	CO.I	In Class Quiz ( Not Accounted)
3,4	Classification of metal casting, Pattern Allowances, Molding Materials	Examine the principles associated with basic operations involving the casting, machining and welding of engineering materials.	Lecture	CO.I	In Class Quiz
5,6	Gating system design	Examine the principles associated with basic operations involving the casting, machining and welding of engineering materials.	Lecture	CO.I	End Term
7.8	Casting defects: Causes and remedies	Examine the principles associated with basic operations involving the casting, machining and welding of engineering materials.	Lecture	CO.I	Home Assignment
9	Casting defects: Causes and remedies and Inspection of castings	Examine the principles associated with basic operations involving the casting, machining and welding of engineering materials.	Lecture	CO.I	End Term
10	Introduction to Machine Tools: Classification of machine tool,	Interpret the geometry of tooling used on various metal cutting machines;	Lecture	CO.II	
11	Introduction to Machine Tools: Classification of machine tool,	Analyse the effects of heat, lubrication and various cutting tool materials on the metal cutting process.	Flipped Class	CO.V	In Class Quiz
12	Mechanics of Metal Cutting: Principles of metal machining, mechanics of chip removal,	Analyse the effects of heat, lubrication and various cutting tool materials on the metal cutting process.	Lecture	CO.V	End Term
13	Mechanics of Metal Cutting: Principles of metal machining, mechanics of chip removal,	Analyse the effects of heat, lubrication and various cutting tool materials on the metal cutting	Flipped Class	CO.V	Class Quiz

		process.			
14	Mechanics of Metal Cutting: Principles of metal machining, mechanics of chip removal,	Analyse the effects of heat, lubrication and various cutting tool materials on the metal cutting process.	Lecture	CO.V	Mid Term I
15,16	Tool signature,	Interpret the geometry of tooling used on various metal cutting machines;	Lecture	CO.II	End Term
17	Tool wear and Tool life,	Interpret the advantages and limitations of each process and its influence on the properties of the material in the finished component;	Lecture, Activity	CO.II	Class Quiz
18	Economics of machining.	Interpret the geometry of tooling used on various metal cutting machines;	Lecture, Activity	CO.II	Mid Term I
19	Metal Joining Processes: An Introduction	Analyse the practical applications of a variety of forming and machining processes.	Lecture	CO.III and IV	End term
20	Principle of welding, soldering, Brazing and adhesive bonding.	Analyse the practical applications of a variety of forming and machining processes.	Lecture	CO.III and IV	Home Assignment
21	Classification of welding and allied processes.	Analyse the practical applications of a variety of forming and machining processes.	Lecture	CO.III and IV	Class Quiz
22	Arc Welding Process	Analyse the practical applications of a variety of forming and machining processes.	Lecture	CO.III and IV	Mid Term I
23	Resistance welding: Spot, Projection and seam welding process,	Analyse the practical applications of a variety of forming and machining processes.	Lecture	CO.III and IV	End Term
24	Atomic hydrogen,	Analyse the practical applications of a variety of forming and machining processes.	Lecture	CO.III and IV	Class Quiz
25	Ultrasonic welding process	Analyse the practical applications of a variety of forming and machining processes.	Lecture	CO.III and IV	Mid Term I
26	Plasma and laser beam welding,	Analyse the practical applications of a variety of forming and machining processes.	Lecture	CO.III and IV	End Term
27	Electron beam welding,	Analyse the practical applications of a variety of forming and machining	Lecture	CO.III and IV	Class Quiz

		processes.			
28,29	Special welding processes e.g. TIG, MIG, friction and explosive welding.	Analyse the practical applications of a variety of forming and machining processes.	Lecture	CO.III and IV	Mid Term I
30,31	Metal Shaping and Forming: Principle and operations, Forging, Forging operations, Forging:	Analyse the practical applications of a variety of forming and machining processes.	Lecture	CO.III and IV	End Term
32,33	Metal working, Elastic and plastic deformation, Hot and cold working, Rolling,	Analyse the practical applications of a variety of forming and machining processes.	Lecture	CO.III and IV	Class Quiz
34,35	Extrusion, Wire and tube drawing processes.	Analyse the practical applications of a variety of forming and machining processes.	Lecture	CO.III and IV	End Term
36, 37	Principle of forging tool design,	Analyse the practical applications of a variety of forming and machining processes.	Lecture	CO.III and IV	Class Quiz
38	Cold working processes: Shearing, Drawing Squeezing, Blanking,	Analyse the practical applications of a variety of forming and machining processes.	Lecture	CO.III and IV	
39	Piercing, deep drawing, Coining and embossing.	Analyse the practical applications of a variety of forming and machining processes.	Lecture	CO.III and IV	End Term
40	Case Base Study-I		NA		Class Quiz
41	Case Base Study-I		NA		NA

**I. Course Articulation Matrix: (Mapping of COs with POs)**

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MCI552.1	Examine the principles associated with basic operations involving the casting, machining and welding of engineering materials.	3							1					2		3
MCI552.2	Interpret the advantages and limitations of each process and its influence on the properties of the material in the finished component;		2	2								2		2		3
MCI552.3	Interpret the geometry of tooling used on various metal cutting machines;				2	2								2		3
MCI552.4	Analyse the practical applications of a variety of forming and machining processes						2		2	3				2		3
MCI552.5	Analyse the effects of heat, lubrication and various cutting tool materials on the metal cutting process.			1						1	1			2		3

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**



# MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Mechatronics Engineering  
Course Hand-out

Intelligent Controller | MC 1704 | 4 Credits | 3 | 0 4

Session: July 19 – Nov 19 | Faculty: Shambo Roy Chowdhury | Class: Prog. Elective

- A. Introduction:** This course is offered by Dept. of Mechatronics Engineering as a core subject, targeting students who wish to pursue research & development in industries or higher studies in field of fuzzy logic, artificial neural network, and genetic algorithms. The course focuses on providing an introduction to the emerging area of intelligent control and optimization using a control-engineering approach. Students are expected to have background knowledge on intelligent controllers for a better learning.
- B. Course Outcomes:** At the end of the course, students will be able to
- [1704.1].** Understand the inspiration behind and requirement of the intelligent control systems.
  - [1704.2].** Understand the intelligent control algorithms based on neural network, fuzzy logic and genetic algorithms.
  - [1704.3].** Comprehend the mathematical basis of various soft computing techniques and relate them for various control applications.
  - [1704.4].** Implement intelligent modelling and optimization of control systems with software tool such as MATLAB or Python to enhance employability skills.
  - [1704.5].** Proficient in developing intelligent systems through case studies and simulation examples.

## C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

- [PO.1].Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- [PO.2].Problem analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- [PO.3].Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- [PO.4].Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- [PO.5]. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- [PO.6].The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- [PO.7].Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- [PO.8].Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.
- [PO.9].Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- [PO.10]. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**[PO.11]. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

**[PO.12].Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

**[PSO.1].** Apply the knowledge of basic sciences, analytical skills and modern computing tools to design, perform and analyse experiments to meet desired goals within the given constraints.

**[PSO.2].** Apply concepts of circuit analysis, analog and digital electronics, controls, electric drives, instrumentation, power systems, machine learning and artificial intelligence to design and automation of mechatronics systems.

**[PSO.3].** Use the principles of solid mechanics, fluid mechanics, strength of materials, advanced functional materials and manufacturing processes to design, manufacture, and commissioning of mechatronics systems.

#### D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	15
	Sessional Exam II (Closed Book)	15
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

## **E. SYLLABUS**

**FUNDAMENTALS:** Fundamentals of Artificial Neural Networks, McCulloch – Pitts model, Activation functions, Feed forward and feedback networks, learning rules – Hebbian, Perceptron, delta, Widrow-Hoff, winner take all, **SINGLE-LAYER FEED FORWARD NETWORKS:** Classifiers, Decision regions, Discriminant functions, minimum distance classification, multi category discrete perceptron training algorithm, **MULTI-LAYER FEED FORWARD NETWORKS:** Linearly non-separable pattern classification, generalized delta learning rule, error back propagation training algorithms, **SINGLE LAYER FEEDBACK NETWORK:** Hopfield network, Boltzman machine, associative memories, performance analysis of energy function reduction, Bi-directional associative memory, **APPLICATION: APPLICATION OF NEURAL NETWORKS:** Control applications, Character recognition, **FUZZY CONTROL:** Introduction to Fuzzy control, membership function, classical sets & fuzzy sets, fuzzy set operations, Fuzzy relations, extension principles, Linguistic variables, Fuzzy IF\_THEN statements, Inference rules, **CONTROLLERS:** Fuzzy knowledge based controllers [FKBC], structure of FKBC, Fuzzification, membership function evaluation using neural networks, genetic algorithms, inductive reasoning, **DEFUZZIFICATION:** Defuzzification methods, Application of fuzzy logic to control systems, Introduction to fuzzy-neural systems, Familiarization with MATLAB Fuzzy logic & neural network Toolbox.

## **TEXT BOOKS**

1. Jacek M. Zurada, Introduction to Artificial Neural Networks, Jaico Publications, 1997.
2. Timothy J. Ross, Fuzzy logic with engineering applications, McGraw Hills Publications, 1997

## **REFERENCE BOOKS.**

1. Yegnanarayana, Artificial Neural Networks, PHI Learning Publications, 2001.
2. Yager & Filev, Essentials of fuzzy modeling and control, Wiley, 1994.
3. Chin-Teng-Lin & C. S. George Lee, Neural Fuzzy Systems, Prentice Hall Publications, 1996.

## F. Lecture Plan:

Lec No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction and Course Hand-out briefing	To acquaint and clear teachers expectations and understand student expectations	Lecture	NA	NA
2,3	Introduction to intelligent controller	Understanding the requirement and inspiration for intelligent control	Lecture	1704.1	In Class Quiz
4,5	ANN- neural models-Mc-culloh pitt model	Introduction to ANN and neural models	Lecture	1704.1,2	In Class Quiz Sessional exam I End Term
6,7	ANN - Activation functions	Understanding ANN functionality	Lecture, activity	1704.2,3	Home Assignment Sessional exam I End Term
8,9	ANN – introduction to architectures	Understanding of the importance of ANN architectures	Lecture	1704.2	In Class Quiz Sessional exam I End Term
10-14	Learning rules	Get inside understanding of how neural network works	Lecture, Activity	1704.2,3,4	Class Quiz Sessional exam II End Term
15-18	Practical aspect of ANN and its utilisation	Will understand and apply ANN with simulation	Lecture, Activity	1704.2,4,5	Class Quiz Sessional exam II End term
19, 20, 21	Application of ANN in control system	Introduction and case study for ANN in control system	Lecture, Flipped Class	1704.2,5	Home Assignment Class Quiz Sessional exam II End Term
22,23	Introduction to fuzziology/ fuzzification	Realise the need of fuzzy system	Lecture	1704.2	Class Quiz Sessional exam II End Term
24-26	Mathematical modelling- Theory	Understand the maths behind fuzzy application	Lecture	1754.2	Class Quiz Sessional exam II End Term
27-29	Mathematical modelling- Practical	Practical analysis of maths for fuzzy system	Activity, flipped class	1754.2,3,4	Class Quiz End Term
30-33	Fuzzy control	Application of fuzzy methods in control system	Lecture	1704.3	Class Quiz End Term
34-37	Practical aspects of fuzzy controller	See the practical aspects of the fuzzy theory and how to apply	Lecture, Activity	1704.3,4	Class Quiz End Term
38,39	Integration of ANN-Fuzzy	Introduction to integration of two intelligent systems	Lecture	1704.2	Class Quiz End Term
40-41	Computation behind ANN-fuzzy systems	Describe mathematics and logic behind success of ANN-Fuzzy systems as well as realize the drawbacks	Lecture	1754.3	Class Quiz End Term
42, 43, 44	Control aspect of ANN – fuzzy systems	Describe the application of ANN – fuzzy systems	Lecture	1704.3	Class Quiz End Term
45,46	Genetic algorithm	Understanding of basic fundamentals of	Lecture	1704.2	Class Quiz End Term

		genetic algorithm			
47-50	Case studies	Involve in simulation analysis of practical systems	Activity	1704.5	Class Quiz End Term

**G. Course Articulation Matrix: (Mapping of COs with POs)**

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MC 1704.1	To understand the inspiration behind the intelligent control systems		2	1										2		
MC 1704.2	To have a basic understanding of neural network, fuzzy logic and genetic algorithms	3	2	2						1				1	2	
MC 1704.3	Learn the mathematical basis of various soft computing techniques	3	2	2										2	2	
MC 1704.4	Correlate theoretical and practical aspects of intelligent modelling, optimization and control of non-linear systems		2				2	1		3				2	1	
MC 1704.5	Experience in developing intelligent systems through case studies, simulation examples		1	1						2	1		1	3	2	

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**



## MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Mechatronics Engineering  
Course Hand-out

**MECHATRONICS SYSTEM DESIGN | MC1706 | 3 Credits | 3 | 0 | 4**

Session: July 19 – Nov 19 | Faculty: Shambo Roy Chowdhury | Class: Core (VII Sem)

**A. Introduction:** This course introduces the approach to design mechatronics systems. This involves the synergistic knowledge of all mechatronics components. The course takes you step by step to design a complete mechatronics system involving individual domain knowledge. The course assumes a prior knowledge on mechatronics components, control algorithms and mechanical mechanisms.

**B. Course Outcomes:** At the end of the course, students will be able

[1706.1]. To revise different components of mechatronic systems

[1706.2]. To learn different components of system design

[1706.3]. To perform mathematical modelling of mechatronics system

[1706.4]. To design control algorithms for mechatronic systems

[1706.5]. To implement and simulate designs using software tools

[1706.6]. To interpret and solve practical problems with knowledge of MSD to enhance employability skills

### C. Program Outcomes and Program Specific Outcomes

**[PO.1]. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

**[PO.2]. Problem analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**[PO.3]. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

**[PO.4]. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

**[PO.5]. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

- [PO.6]. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- [PO.7]. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- [PO.8]. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.
- [PO.9]. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- [PO.10]. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- [PO.11]. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- [PO.12]. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
- [PSO.1].** Apply the knowledge of basic sciences, analytical skills and modern computing tools to design, perform and analyse experiments to meet desired goals within the given constraints.
- [PSO.2].** Apply concepts of circuit analysis, analog and digital electronics, controls, electric drives, instrumentation, power systems, machine learning and artificial intelligence to design and automation of mechatronics systems.
- [PSO.3].** Use the principles of solid mechanics, fluid mechanics, strength of materials, advanced functional materials and manufacturing processes to design, manufacture, and commissioning of mechatronics systems.

#### D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (closed book)	15
	Sessional Exam II(closed book)	15
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance	A minimum of 75% Attendance is required to be maintained by a	

(Formative)	student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.

## E. Syllabus

Introduction: Mechatronics Design process, Design Parameters, Traditional and Mechatronics designs – Advanced approaches in Mechatronics, Industrial design, and ergonomics, safety. System Modelling: Introduction-model categories-fields of application-model development-model verification-model validation-model simulation-design of mixed systems-electro mechanics design-model transformation- domain-independent description forms-simulator coupling. Actuators: Characteristics and applications of the Mechanical, electrical, Hydraulic and pneumatic actuator, shape memory alloys and their limitations. Sensors and transducers for motion measurement. Control parameters and system objectives, Mechanical configurations, popular control system configurations. Design with linear slides, Motion control Algorithms: significance of feedforward and feedback control loops, shortfalls, Architecture of Intelligent Machines: System design Classification, Motion control aspects of Design. Human and Machine, Machine Interfacing devices and strategy, Machine Vision: Feature and Pattern Recognition methods, concepts of perception and cognition in decision making. Case study: case study 1 and case study 2.

## F. Text Books

1. W. Bolten, *Mechatronics*, Addison Wesley Longman Ltd, 1999.
2. D. Shetty & R. Kolk, *Mechatronics System Design*, PWS Publishing.

## Reference Books

1. M. B. Histan and D. G. Alciatore, *Designing Intelligent Machines*, Open University,

London.

2. D.A. Bradley and others, *Mechatronics*, Chapman & Hall Publications.
3. D. Nesculescu, *Mechatronics*, Pearson Education Pvt. Ltd. 2002.
4. C.W. Desi, *Control sensors and actuators*, Prentice Hall Publications.
5. Alcitore, Michael B. Histan, David G. Alciatore, *Introduction to mechatronics and measurement systems*, Tata MCGraw Hill.

#### G. Lecture Plan:

Lec No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction and Course Hand-out briefing	To acquaint and clear teachers expectations and understand student expectations	Lecture	NA	NA
2,3	Components of mechatronics	Introductory revision to different components of mechatronics	Lecture	1706.1	In Class Quiz ( Not Accounted)
4	Sensors	Revision of sensors	Lecture	1706.1	In Class Quiz Sessional exam I End Term
5-6	Actuators	Revision of actuators	Lecture	1706.1	Home Assignment Sessional exam I End Term
7	Processors	Revision of processors	Lecture	1706.1	In Class Quiz Sessional exam II End Term
8,9	Signal acquisition	Revision of signal acquisition strategies	Lecture, Activity	1706.1	Class Quiz Sessional exam II End term
10,11	Control system	Revision of control algorithms	Lecture	1706.1	Home Assignment Class Quiz Sessional exam II End Term

12-15	System modelling	Introduction to various concepts of system modelling	Lecture	1706.2, 1706.4	Class Quiz Sessional exam II End Term
16-20	Mechanical modelling	Mathematical derivation of mechanical components	Lecture, Activity	1706.3	Class Quiz Sessional exam II End Term
21-25	Model simulation	Simulation using CAD	Lecture, activity	1706.3, 1706.5	Class Quiz End Term
26 - 30	Control models	Mathematical modelling for control implementation	Lecture	1706.3	Class Quiz Mid Term II End Term
31-35	Model simulation	Simulation using MATLAB	Lecture, activity	1706.3, 1706.5	Class Quiz End Term
36-45	Example	Solving example of designs of mechatronic systems	Flipped class, activity	1706.5, 1706.6	Class Quiz End Term
46-48	Advantage and disadvantages	Describe the requirements of MSD	Lecture	1706.6	Class Quiz End Term
49-50	Conclusion	Conclude the course	Lecture	1706.1	NA

### H. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MC 1706.1	To revise different components of mechatronic systems	1		1		3				1			1	1	2	2
MC 1706.2	To learn different components of system design	1	2	2		2	1	1	1			1	1	1	1	1
MC 1706.3	To perform mathematical modelling of mechatronics system	1	3	3	2	2								2		3
MC 1706.4	To design control algorithms for mechatronic systems	1	3	2	2	2								2	2	1
MC 1706.5	To implement and simulate designs using software tools	1	1	3	2	2							1	1	1	1
MC 1706.6	To interpret and solve practical problems with knowledge of MSD	1	3	1	2	2								1	1	1

I- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation





**MANIPAL UNIVERSITY JAIPUR**  
School of Automobile Mechanical and Mechatronics Engineering  
Department of Mechatronics Engineering  
Course Hand-out

COMPUTER INTIGRATED MANUFACTURING | MC1707 | 3 Credits | 3 0 0 3

Session: July 19 – Nov 19 | Faculty: Varun. J | Class: Departmental Core

**INTRODUCTION:** This course is offered by Dept. of Mechatronics Engineering as a core course. This course is designed to give a clear understanding of the concepts underlying the industrial robotic design. Simple mathematical methods are preferred to design a mechanical kinematic and dynamic and programming of industrial robot.

**B. COURSE OUTCOMES:** At the end of the course, students will be able to

[MC 1707.1] To understand the basics of NC, CNC, and DNC and Understanding CNC codes for different machining operations thereby making students employable in automated manufacturing systems

[MC 1707.2] To understand the basics of Group Technology, Flexible Manufacturing Process and Computer Integrated Manufacturing and learn their areas of applications.

[MC 1707.3] To learn about Single Station Manned /Automated Workstations and analyse the performance of Single Station Automated Cells, Parts Storage Subsystem and Automatic Parts Transfer systems and thus improving skills in automation systems.

[MC 1707.4] To Analyse Automated Flow Line and to learn fundamentals of line balance.

[MC 1707.5] To understand Computerized Manufacturing Planning Systems and Computer aided Process planning.

**C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES**

[PO.1].**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

[PO.2].**Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

[PO.3].**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

[PO.4].**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

[PO.5]. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

**[PO.6].The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

**[PO.7]. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

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**[PO.9]. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**[PO.10].Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

**[PO.11] Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

**[PO.12]. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

**[PSO.1].** Apply the knowledge of basic sciences, analytical skills and modern computing tools to design, perform and analyse experiments to meet desired goals within the given constraints.

**[PSO.2].** Apply concepts of circuit analysis, analog and digital electronics, controls, electric drives, instrumentation, power systems, machine learning and artificial intelligence to design and automation of mechatronics systems.

**[PSO.3].** Use the principles of solid mechanics, fluid mechanics, strength of materials, advanced functional materials and manufacturing processes to design, manufacture, and commissioning of mechatronics systems.

**D. Assessment Rubrics:**

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	15
	Sessional Exam II (Closed Book)	15
	Quizzes and Assignments	30
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity classroom participation by a student will be assessed and marks will be awarded.	

**E. SYLLABUS:**

Development in Machine Tools, Components of NC Machine, Problem with conventional NC, CNC Machine, CNC programming: Co-ordinate systems, Manual data input, Distributed Numerical Control, Adaptive Control Machining System, Group Technology , FMS and CIM: Part families – Part classification and coding, production flow analysis, Computer Integrated Manufacturing System, Automated Storage/Retrieval Systems, Flexible Manufacturing System, Single Station Manned /Automated Workstations: Single Station Automated Cells, Parts Storage Subsystem and Automatic Parts Transfer. Analysis of Automated Flow Line & Line Balancing: General terminology and analysis, Analysis of Transfer Line Manual Assembly lines, line balancing problem. Computerized Manufacturing Planning Systems: Computer aided Process planning, Computer integrated planning systems, factory data collection systems, automatic identification systems.

**Primary References:**

1. M. Thomas Crandell, CNC Machining and Programming an Introduction, Industrial Press Inc., New York, 200
- 2.
2. P. Groover Mikell, Automation, Production Systems, and computer Integrated manufacturing, Prentice Hall of India, New Delhi, 2003.

**Secondary References:**

1. K. Yoram, Ben and U. Joseph, Numerical Control of Machine Tools, Khanna Publishers, New Delhi, 2005.
2. Mikell P. Groover, and Emory W. Zimmers, Computer aided design and manufacturing, Prentice Hall of India, New Delhi, 2003.
3. P. Radhakrishnan, Computer Numerical Control Machines, New Central Book Agency Pvt. Ltd., Kolkata 2004 .
4. HMT Limited, Mechatronics, Tata McGraw Hill, New Delhi, 1998.
5. P.N Rao, CAD/CAM, Tata McGraw Hill, New Delhi, 2005.
6. James Madison, CNC Machining Hand Book, Industrial Press Inc, New York, 1996.
7. Smid Peter, CNC programming Hand book, Industrial Press Inc., New York, 2000.
8. K Yoram, Computer Control of Manufacturing Systems, and Computer Integrated Manufacturing, McGraw Hill Publications, Singapore, 1983.

**Lecture Plan:**

Lec. No	Topics	Session Objective	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1-2	Introduction and Course Hand-out briefing	To acquaint and clear teachers expectations and understand student expectations	Lecture	NA	NA
3-4	Development in Machine Tools	To understand basics of machine tools	Lecture	CO.1	Class Quiz
5-7	Components of NC Machine, Problem with conventional NC, CNC Machine	NC, CNC and DNC fundamentals	Lecture/Flipped Class	CO.1	Home Assignment
8-9	CNC programming: Co-ordinate systems, Manual data input, Distributed Numerical Control,	CNC programming development	Lecture	CO.1	Class Quiz
10-11	CNC programming: Co-ordinate systems, Manual data input, Distributed Numerical Control,	CNC programming development	Lecture	CO.1	Home Assignment
13-16	Adaptive Control Machining System, Group Technology	Basics of adaptive control system and group technology introduction	Lecture	CO.2	Class Quiz
17-22	Part families – Part classification and coding, production flow analysis, Computer Integrated Manufacturing System,	Part classification and coding techniques	Lecture	CO.2	Home Assignment
23-25	Automated Storage/Retrieval Systems, Flexible Manufacturing System,	Industrial ASRS system and introduction to FMS	Lecture/Flipped Class	CO.3	Class Quiz

26-30	Single Station Manned /Automated Workstations: Single Station Automated Cells, Parts Storage Subsystem and Automatic Parts Transfer	To understand the single cell manned and automated workstation design	Lecture	CO.4	Home Assignment
31-34	Analysis of Automated Flow Line & Line Balancing: General terminology and analysis, Analysis of Transfer Line Manual Assembly lines, line balancing problem	Learn about automated flow lines (manual and automated)	Lecture	CO.4	Class Quiz
35-36	Computerized Manufacturing Planning Systems: Computer aided Process planning,	Learn about CAPP	Lecture	CO.5	Home Assignment
36-38	Computer integrated planning systems, factory data collection systems, automatic identification systems.	How the CAPP and factory data are integrated	Lecture	CO.5	Home Assignment

## F. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELTION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MC1707.1	To understand the basics of NC, CNC, and DNC and developing CNC codes for different machining operations.	2	3	2										1	1	0
MC1707.2	To understand the basics of Group Technology, Flexible Manufacturing Process and Computer Integrated Manufacturing and learn their areas of applications.	2	3	1										0	1	1
MC1707.3	To learn about Single Station Manned /Automated Workstations and analyse the performance of Single Station Automated Cells, Parts Storage Subsystem and Automatic Parts Transfer systems.	2	2	3			2			2				1	1	1
MC1707.4	To Analyse Automated Flow Line and to learn fundamentals of line balance.	1	2	2	2							2		1	1	1
MC1707.5	To understand Computerized Manufacturing Planning Systems and Computer aided Process planning.	2		2	1	3						2		1	1	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation



# MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Mechatronics Engineering

Course Hand-out

Micro Electro Mechanical Systems (MEMS)| MC1755 | 3 Credits | 3 0 0 3

Session: July 19 – Nov 19 | Faculty: Anil Sharma | Class: Departmental Elective

- A. Introduction:** The objective of this course is to make students to gain basic knowledge on overview of MEMS (Micro electro Mechanical System) and various fabrication techniques. This enables them to design, analysis, fabrication and testing the MEMS based components. And to introduce the students various opportunities in the emerging field of MEMS.

**Course Outcomes:** *At the end of the course, students will be able to*

**[MC1755.1]** Analyse the working principles of currently available micro sensors, actuators, motors, valves, pumps, and fluidics used in microsystems.

**[MC1755.2]** Apply different scaling laws that are used extensively in the conceptual design of micro devices and systems.

**[MC1755.3]** Analyse different materials available for MEMS based processes and select materials for various MEMS devices.

**[MC1755.4]** Assess various techniques used in micro-fabrication processes and applications. Students will be able to differentiate between the positive and negative consequences of certain processes that are pertinent to microsystems.

**[MC1755.5]** Evaluate a micromachining technique, such as bulk micromachining and/or surface micromachining for the fabrication of specific MEMS device considering its working principle to enhance employability skills.

## **B. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES**

**[PO.1].Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

**[PO.2].Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

**[PO.3].Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

**[PO.4].Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

**[PO.5].Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

**[PO.6].The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

**[PO.7].Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

**[PO.8].Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices

**[PO.9].Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

**[PO.10]. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

**[PO.11]. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

**[PO.12]. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

**[PSO.1].** Apply the knowledge of basic sciences, analytical skills and modern computing tools to design, perform and analyse experiments to meet desired goals within the given constraints.

**[PSO.2].** Apply concepts of circuit analysis, analog and digital electronics, controls, electric drives, instrumentation, power systems, machine learning and artificial intelligence to design and automation of mechatronics systems.

**[PSO.3].** Use the principles of solid mechanics, fluid mechanics, strength of materials, advanced functional materials and manufacturing processes to design, manufacture, and commissioning of mechatronics systems.

### C. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	15
	Sessional Exam II (Closed Book)	15
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 3 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

## **D. SYLLABUS**

Introduction to MEMS and Microsystems: Products, Evolution of micro-fabrication, microelectronics, miniaturization, application in the automotive and other industries, Working principles of Microsystems: Micro sensors, Micro actuation, Scaling laws in miniaturization: Scaling in geometry, Scaling in rigid body dynamics, Scaling in electrostatic, electromagnetic forces, Scaling in electricity, Scaling in heat transfer and fluid mechanics, Materials for MEMS and microsystems: Substrates and wafers, Silicon as a substrate material, silicon compounds, silicon piezo-resistors, Gallium arsenide, Quartz, Polymers, Packaging materials, Problems, Microsystems fabrication Processes: Photo lithography, Ion implantation, Diffusion, Oxidation, Chemical vapor deposition, Physical vapor deposition, Deposition by Epitaxy, Etching, Problems, Micro-manufacturing: Bulk manufacturing, Surface micromachining, LIGA process, Microsystems Design: Design consideration, Process design, Mechanical design, Design of a silicon die, Design of microfluidic Network system. Case studies.

## **E. Text Book :**

1. T. R. Hsu, MEMS and Microsystems - Design and Manufacturing, Tata McGraw Hill.
2. Chang Liu, Foundations of MEMS, Pearson Education – 2012.

## **F. References :**

1. W. Menz, J. Mohr, O. Paul, Microsystem Technology, Wiley Publications, 2001.
2. M. Gad-el-Hak, The MEMS Handbook, CRC Press, 2002.
3. Marc J. Madou, Fundamentals of Micro fabrication: The Science of Miniaturization, CRC Press, 2002.

Web – edX course on MEMS and Micro-fabrication

**G. Lecture Plan:**

Lecture S.no.	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
L1	Introduction to MEMS & Microsystems	NA	Lecture, Presentation	CO.1	NA
L2	Introduction to Microelectronics and micro sensors, actuators	Explore the scope of MEMS in various industries.	Lecture, Presentation	CO.1	In class quiz
L3	Evaluation of MEMS, Micro sensors, Market Survey	Assess the working principles of currently available micro sensors, actuators	Presentation	CO.1	In class quiz
L4	Application of MEMS		Lecture	CO.1	Sessional Exam
L5	Working principles of Microsystems: Micro sensors , Micro actuation		Lecture, Presentation	CO.1	Sessional Exam
L6	Scaling laws in miniaturization	Learn about the effects of different phenomenon at micro scale	Lecture, Presentation	CO.2	Home assignment
L7	Scaling laws in miniaturization (Contd.)		Class activity	CO.2	Home assignment
L8	MEMS Materials	Analyse different materials available for MEMS based processes.	Lecture, presentation	CO.3	Home assignment
L9	MEMS Materials Properties		Lecture, presentation	CO.3	Sessional Exam
L10	MEMS fabrication – Introduction	Understand the basic principles and applications of micro-fabrication processes, such as photolithography, ion implantation, diffusion, oxidation, CVD, PVD, and etching.	Lecture, presentation	CO.1, CO.4	Sessional Exam
L11	Microsystems fabrication Processes - I		Lecture	CO.1, CO.4	In class quiz
L12	Microsystems fabrication Processes –II		Lecture, presentation	CO.1, CO.4	In class quiz
L13	Microsystems fabrication Processes (Contd.)		Presentation	CO.1, CO.4	Sessional Exam
L14	Micro-manufacturing : Bulk manufacturing, examples	Identify a micromachining technique, such as bulk micromachining and/or surface micromachining for a specific MEMS fabrication process.	Presentation	CO.5	Sessional Exam
L15	Micro-manufacturing : surface manufacturing, examples		Lecture, presentation	CO.5	Sessional Exam
L16	Micro-manufacturing : LIGA Process		Lecture, presentation	CO.5	In class quiz
L17	Etch Stop Techniques and Microstructure	Understand the pros and cons of different micro manufacturing process	Presentation	CO.5	In class quiz
L18	Surface and Quartz Micromachining		Presentation	CO.5	In class quiz

L19	Fabrication of Micro machined Microstructure		Lecture	CO.5	In class quiz
L20	Micro-stereolithography		Lecture	CO.5	In class quiz
L21	Microsystems Design: Design consideration, Process design		Lecture	CO.5	Sessional Exam
L22	Mechanical design, Design of a silicon die		Lecture, presentation	CO.5	Sessional Exam
L23	Design of microfluidic Network system	<p>Understand the working principles of currently available micro sensors, actuators with applications.</p> <p>Resource planning for a given microsystem fabrication and application</p> <p>Identify how physical and chemical phenomena affect micro systems for various applications</p>	Lecture	CO.4	In class quiz
L24	Microsystems Design problems		Lecture, presentation	CO.4	In class quiz
L25	MEMS Micro sensors (Thermal)		Lecture	CO.4	In class quiz
L26	Micro machined Micro sensors (Mechanical)		Lecture, presentation	CO.4	Sessional Exam
L27	MEMS Pressure and Flow Sensor		Lecture, presentation	CO.4	Sessional Exam
L28	MEMS Inertial Sensors		Class activity	CO.1, CO.4	End Semester Exam
L29	MEMS Micro accelerometers		Class activity	CO.1, CO.4	End Semester Exam
L30	Piezo resistive Accelerometer Technology		Lecture	CO.1, CO.4	End Semester Exam
L31	MEMS Capacitive Accelerometer		Lecture, Class activity	CO.1, CO.4	Home Assignment
L32	MEMS Capacitive Accelerometer Process		Class activity	CO.1, CO.4	Home Assignment
L33	MEMS Gyro Sensor		Class activity	CO.1, CO.4	Home Assignment
L34	Interface Electronics for MEMS		Lecture	CO.1	Student presentation
L35	Introduction to Bio-MEMS		presentation	CO.1	Student presentation
L36	Case Studies 1		Presentation	CO.1	Student presentation
L37	Case Studies 2		Lecture, presentation	CO.1	Student presentation
L38	Case Studies 3	Explore recent advancements in the field of MEMS and devices and future aspects.	Lecture, presentation	CO.4	Student presentation
L39	Signal mapping and transduction		Class activity	CO.1	Student presentation
L40	Revision		Class activity	CO.1	NA

## H. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MC1755.1	Analyse the working principles of currently available micro sensors, actuators, motors, valves, pumps, and fluidics used in microsystems.	3	1		1		1						1	1	1	3
MC1755.2	Apply different scaling laws that are used extensively in the conceptual design of micro devices and systems.	3	1	2										3	2	2
MC1755.3	Analyse different materials available for MEMS based processes and select materials for various MEMS devices.	3		2	2									1		3
MC1755.4	Asses various techniques used in micro-fabrication processes and applications. Students will be able to differentiate between the positive and negative consequences of certain processes that are pertinent to microsystems.	3	2		2									1		3
MC1755.5	Evaluate a micromachining technique, such as bulk micromachining and/or surface micromachining for the fabrication of specific MEMS device considering its working principle.	3		2	1	2										2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation



# MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Mechatronics Engineering  
Course Hand-out

Artificial Intelligence| MC 1756 | 3 Credits | 3 0 0 3

Session: July 19 – Dec 19 | Faculty: Ashok Kumawat | Class: Program Elective

**A. Introduction:** This course is offered by Department of Mechatronics Engineering as a department elective, targeting students who wish to pursue research & development in industries or higher studies in field of Mechatronics Engineering, including robotics, intelligent controllers, soft computing etc. This course will provide a broad understanding of the basic techniques for building intelligent computer systems and an understanding of how Artificial Intelligence is applied to problems. Students are expected to have background knowledge on algorithms and programming for a better learning.

## B. Course Objectives:

- [1756.1]. Understand the fundamentals of Artificial Intelligence, intelligent agents and various AI search algorithms.
- [1756.2]. Apply knowledge representation, reasoning, and machine learning techniques to real-world problems.
- [1756.3]. Explain the role of logical agents and planning in AI
- [1756.4]. Apply ANN, uncertain knowledge and reasoning in AI, hence develop employability skills.
- [1756.5]. Applications of AI (Natural Language Processing, Robotics etc.)

## C. Program Outcomes and Program Specific Outcomes

[PO.1]. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

[PO.2]. **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

[PO.3]. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health

and safety, and the cultural, societal, and environmental considerations

[PO.4]. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

[PO.5]. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

[PO.6]. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal,

health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

[PO.7]. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

- the
- [PO.8]. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practices
- [PO.9]. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
- [PO.10]. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
- [PO.11]. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments
- [PO.12]. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
- [PSO.1].** Apply the knowledge of basic sciences, analytical skills and modern computing tools to design, perform and analyze experiments to meet desired goals within the given constraints.
- [PSO.2].** Apply concepts of circuit analysis, analog and digital electronics, controls, electric drives, instrumentation, power systems, machine learning and artificial intelligence to design and automation of mechatronics systems.
- [PSO.3].** Use the principles of solid mechanics, fluid mechanics, strength of materials, advanced functional materials and manufacturing processes to design, manufacture, and commissioning of mechatronics systems.

#### D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I	15
	Sessional Exam II	15
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

## E. Syllabus

**Introduction** to AI and intelligent agents. Uninformed search, Heuristic search, stochastic search, adversarial search, game playing. **Machine Learning**: basic concepts, linear models, perceptrons, **neural networks**, naive Bayes, Decision trees, ensemble, logistic regression, and unsupervised learning. Constraint satisfaction problems, Markov decision processes, reinforcement learning. **Logical agents**, propositional logic and first order logic, planning, partial order planning, Bayesian Networks, natural language processing, **AI applications**.

## F. Text Books

T1. Stuart Russell and Peter Norvig, "Artificial Intelligence, A Modern Approach", 3<sup>rd</sup> Edition, Pearson Education, 2015.

T2. Kevin Knight, Eline Rich B.Nair, "Artificial Intelligence", McGraw Hill Education 3<sup>rd</sup> edition 2012.

### Reference Books

R1. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007

R2. George F. Luger, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson Education Asia(2009).

**G. Lecture Plan:**

Lecture No.	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction to AI	Brief introduction about AI	Lecture	1756.1	In Class Quiz Mid Term I End Term
2,3,4	Intelligent agents	Understanding about agents	Lecture	1756.1	In Class Quiz Mid Term I
5,6	Introduction to solving problems by searching	Identify different searching algorithms	Lecture	1756.1	In Class Quiz End Term
6,7	Uninformed search	Implementation of uninformed search algorithms	Lecture	1756.1	Home Assignment End Term
7,8	Heuristics search	Recall heuristics search and implementation	Lecture	1756.1	In Class Quiz End Term
9,10	Games	Basics to design games using AI	Activity (Think Pair Share)	1756.1	Class Quiz Mid Term I End Term
10,11,12	Constraint satisfaction problems	Backtracking search for CSPs, Local search for CSPs	Lecture, Activity (Jigsaw)	1756.1	Class Quiz Mid Term I End term
13,14	Logical agents	Basics of knowledge based agents	Lecture, Flipped Class	1756.3	Home Assignment Class Quiz Mid Term I End Term
15,16	Proportional logic	Recall agents and explanation of proportional logic	Lecture, Activity (Think Pair Share)	1756.3	Class Quiz Mid Term I End Term
17,18,19	First order logic	Recall agents and implementation of first order logic	Lecture	1756.3	Class Quiz Mid Term I End Term
20,21,22	Planning	Algorithms for planning and implementation using MATLAB/Python	Lecture	1756.3	Class Quiz End Term
23,24,25,26	Probabilistic Reasoning, Bayesian Networks	Explanation of probabilistic reasoning and Bayesian networks	Lecture	1756.4	Class Quiz Mid Term II End Term
27,28	Bayes rule	Describe the Bayes rule	Lecture, Activity	1756.2	Class Quiz Mid Term II End Term

29	Markov decision processes	Describe the Markov process	Lecture, Activity	1756.4	Class Quiz Mid Term II End Term
30	supervised and unsupervised learning	Basics of learning and types of learning	Lecture	1756.2	Class Quiz Mid Term II End Term
31	Machine Learning basic concepts	Basic concepts of machine learning	Lecture	1756.2	Class Quiz End Term
32	Linear models	Describe the linear models	Lecture	1756.2	Class Quiz End Term
33	Decision trees	Describe the decision trees	Lecture	1756.2	Class Quiz End Term
34	Regression	Explanation of regression approach	Lecture	1756.4	Class Quiz End Term
35	Logistic regression	Describe the logistic regression	Lecture	1756.4	Class Quiz End Term
36	Ensemble learning	Describe the ensemble learning	Lecture	1756.2	Class Quiz End term
37	Artificial neural network	Basics of ANN	Lecture	1756.4	Class Quiz
38	Reinforcement learning	Recall learning and explain reinforcement learning	Lecture	1756.2	Class Quiz Mid Term II End Term
39	Natural language processing	Explain natural processing	Lecture	1756.5	Class Quiz Mid Term II End Term
40,41	AI applications	Recall AI algorithms and implementation in various applications	Lecture and implementation	1756.5	Class Quiz Mid Term II End Term
42	Conclusion and Course Summarization	NA	NA		NA

### H. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MC 1756.1	Understand the fundamentals of Artificial Intelligence, intelligent agents and various AI search algorithms.	1	1											1	1	1
MC 1756.2	Apply knowledge representation, reasoning, and machine learning techniques to real-world problems.	1	2	2	2	2	1							2	2	2
MC 1756.3	Explain the role of logical agents and planning in AI	1	2	1	1	2	1							1	1	1
MC 1756.4	Apply ANN, uncertain knowledge and reasoning in AI.	1	2	1	1	2	1			1				1	2	1
MC 1756.5	Applications of AI (Natural Language Processing, Robotics etc.)	1	3	2	2	2	1			1				1	1	1

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**



**MANIPAL UNIVERSITY JAIPUR**  
School of Automobile Mechanical and Mechatronics Engineering  
Department of Mechatronics Engineering  
Course Hand-out

Biomedical Instrumentation | MC1757 | 3 Credits | 3 0 0 3

Session: July 19 – Nov 19 | Faculty: Princy Randhawa | Class: Program Elective

**A. INTRODUCTION:** This course will cover various systems of the human physiology, signals of biological origin obtained from these systems, biosensors, transducers, bio electrodes used to acquire such signals, and amplifiers for measuring bio potentials. Electrical safety of medical devices; measurements of the blood pressure, blood flow, respiratory system, clinical laboratory equipment, medical imaging, and bioethics will also be discussed. The main objective of this course is to introduce student to basic biomedical engineering technology. As a result student can understand, design and evaluate systems and devices that can measure, test and/or acquire biological information from the human body.

**B. COURSE OUTCOMES:** At the end of the course, students will be able to

**CO.1 [MC1757.1]** Outline the basic knowledge about human anatomy and physiological system.

**CO.2 [MC1757.2]** Describe the origin of bio potential and explain the role of bio potential electrodes.

**CO.3 [MC1757.3]** Explain and contrast measurement principles for blood flow, Blood pressure and volume as well as Respiratory variables.

**CO.4 [MC1757.4]** Inspect common biomedical signals, Electrodes, Biomedical Recorders and identify common Signal artefacts, their sources and formulate strategies for their suppression.

**CO.5 [MC1757.5]** Analyze and examine the common imaging and therapeutic techniques and equipment in the medical field of study.

**CO.6 [MC1757.6]** Identify, explain and judge patient safety issues related to biomedical instrumentation.

**C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES**

**[PO.1].Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

**[PO.2].Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**[PO.3].Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations..

**[PO.4].Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

**[PO.5]. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

**[PO.6].The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**[PO.7]. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

**[PO.8]. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices

**[PO.9]. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**[PO.10].Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**[PO.11] Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

**[PO.12]. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

**[PSO.1].** Apply the knowledge of basic sciences, analytical skills and modern computing tools to design, perform and analyse experiments to meet desired goals within the given constraints.

**[PSO.2].** Apply concepts of circuit analysis, analog and digital electronics, controls, electric drives, instrumentation, power systems, machine learning and artificial intelligence to design and automation of mechatronics systems.

**[PSO.3].** Use the principles of solid mechanics, fluid mechanics, strength of materials, advanced functional materials and manufacturing processes to design, manufacture, and commissioning of mechatronics systems.

**Class Schedule:**

3 hours a week, 60 minutes a lecture, 38-45 lectures a semester.

**Primary References:**

Handbook of Biomedical Instrumentation, R.S.Khandupur-Tata McGraw Hill.

Introduction of Biomedical Equipment’s, Carr-Pearson Education.

Medical Instrumentation: Application and Design, 3ed-, Webster, Wiley

**Secondary References:**

Medical Instrumentation Application and Design, John, Oxford

Advanced Methods of Biomedical Signal Processing, Sergio Cerutti, Oxford.

Medical and Clinical Engineering, Jacobson, B. Webster, J.G.-Prentice Hall, International.

Biomedical Instrumentation and Measurements, Cromwell-et al, Prentice Hall, International.

**Assessment Rubrics:**

Criteria	Description	Maximum Marks
Internal Assessment	Sessional Exam I (Closed Book)	20
	Sessional Exam II (Closed Book)	20

(Summative)	<ol style="list-style-type: none"> <li>1. Review Paper</li> <li>2. Research, Analyze biomedical application and simulate</li> <li>3. Seminar</li> </ol>	10 10  10
End Term Exam (Summative)	End Term Exam (Closed Book)	50
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity classroom participation by a student will be assessed and marks will be awarded.	

**SYLLABUS:**

Physiology and transducers– resting and action potential – nervous system: functional organisation of the nervous system – structure of nervous system, neurons components of biomedical system - transducers – selection criteria –electro – physiological measurements -bioelectric signals and electrodes–amplifiers: preamplifiers. ECG– EEG–EMG –lead systems and recording methods – typical waveforms. Non-electrical parameter measurements-measurement of blood pressure – cardiac output – heart rate – heart sound pulmonary function measurements –, biomedical recorders blood gas analysers: ph of blood –measurement of blood pco<sub>2</sub>, po<sub>2</sub>, ESR, GSR measurements, blood cell counters. Medical imaging - cat techniques — MRI–ultrasonography – endoscopy– thermography – different types of biotelemetry systems and patient monitoring assisting and therapeutic Equipments -cardiac pacemakers – defibrillators – ventilators– diathermy–heart – lung machine –dialysers, CASESTUDY-Study and Analysis of EMG Signals using LABVIEW

**Lecture Plan:**

Lec. No	Topics	Session Objective	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction and Course Hand-out briefing	To acquaint and clear teachers expectations and understand student expectations	Lecture	NA	NA
2	Introduction to Instrumentation and Biomedical Instrumentation	To understand the definition of few terms	Lecture	CO.1	In Class Quiz ( Not Accounted) Mid term 1 End Term
3,4	Brief description of neural activities, cardiovascular and respiratory systems;	To understand the anatomy structure of human body	Lecture	CO.1	In Class Quiz Mid Term 1 End Term
5,6	Muscular their electrical, mechanical and chemical activities, Introduction to Transducers and Electrodes	To learn about the Physiological system of the body and the sources of biomedical signals	Group Activity	CO.1	Home Assignment Mid Term 1 End Term
7-10	Principles and classification of transducers for Bio-medical applications, Bio-electric potential	To study the origin of Bioelectric signals and its electrical activity	Lecture,	CO.2	Home Assignment Mid Term 1 End Term
11	Selection criteria for transducers and electrodes, Electrical activity of excitable cells. Neuron potential.	To understand the characteristics about the transducers	Flipped Classroom	CO.2	Home Assignment Class Quiz Mid Term 1 End Term
12-14	Bioelectric signals and Electrodes, ECG	To Analyze the block diagram description of and ECG and the leads used and its waveforms	Lecture	CO.4	Seminar Mid Term 1 End Term
15,16	EEG, EMG, ERG, EOG and its electrodes and block diagram	To Analyse the electrical activity of the grain , muscles, eye	Lecture	CO.4	Seminar Mid Term 2 End Term
17	Measurement of Blood pressure and its methods, Measurement of Heart rate	Acquaint students with the brief overview of Systolic and diastolic	Lecture	CO.3	Class Quiz Mid Term 2

		pressure			End Term
18-19	Blood flow meters-Types Cardiac Output- Different types of Methods	To study different methods for the measurement of pressure and blood flow.	Lecture	CO.3	Class Quiz, Case Study Mid Term 2 End Term
20	Biomedical telemetry and Telemedicine- Wireless, Single channel, Multichannel	To acquaint the students about the biotelemetry-communication between implanted devices and the external world.	Flipped Classroom	CO.8	Class Quiz Mid Term 2 End Term
21	Patient monitoring system- Bedside PMS Measurement of Respiration rate	To understand students about the qualitative assessment of the important physiological variables of the patients during critical periods of their biological functions.	Lecture	CO.8	Case Study Mid Term 2 End Term
22-24	Blood Gas Analyzers-pH measurement,pO <sub>2</sub> and pCO <sub>2</sub> measurement	To study the importance of measuring pH , pCO <sub>2</sub> ,pO <sub>2</sub> of the body fluids with the special reference to the human blood	Lecture	CO.3	Class Quiz Mid Term 2 End Term
25	Spectrophotometry-types and its applications	To Analyze the methods of the analysis in clinical chemistry of the body	Lecture	CO.3	Class Quiz Mid Term 2 End Term
26	ESR, GSR measurement	To understand the haematology of the blood and its measurement methods	Lecture	CO.5	Class Quiz Mid Term 2 End Term
27-30	X-ray machines-CT scan , NMR techniques, MRI, Thermal Imaging system	To acquaint the students about the radiological examination and various imaging techniques to see inside the human body	Lecture	CO.8	Class Quiz End Term
31-32	Ultrasound imaging system-Echocardiograph	To understand the few terms like ultrasonic waves, Doppler effect and same principle to be used in ultrasound imaging systems along with X-ray and nuclear medicine	Lecture	CO.8	Home Assignment End Term
33-35	Cardiac Pacemakers, Cardiac Defibrillators, Ventilators, Diathermy-Physiotherapy and Electrotherapy equipment	To analyse different therapeutic equipment	Lecture	CO.7	Class Quiz End Term
36	Patient safety-electric shock hazards, safety codes, and leakage currents	To examine about the different kinds of shocks and its safety measures	Lecture	CO.6	Class Quiz
37	Revision	NA	NA, Flipped Classroom	NA	NA

# I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MC 1757.1	Outline the basic knowledge about human anatomy and physiological system.	1		1			1									
MC 1757.2	Describe the origin of bio potential and explain the role of bio potential electrodes.	1		2			1							1		
MC 1757.3	Explain and contrast measurement principles for blood flow, Blood pressure and volume as well as Respiratory variables.	1	1			3	1								1	
MC 1757.4	Inspect common biomedical signals, Electrodes, Biomedical Recorders and Identify common signal artefacts, their sources and formulate strategies for their suppression.		1	3	1	1	2	1							1	
MC 1757.5	Analyze and examine the common imaging and therapeutic techniques and equipment in the medical field of study.		2	1			1							1	1	
MC 1757.6	Identify, explain and judge patient safety issues related to biomedical instrumentation.		2	3			1							1		

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**



# MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Mechatronics Engineering

Course Hand-out

Computer Networking & Communications Protocol| MC 1759 | 3 Credits | 3 0 0 3

Session: July 19 – Nov 19 | Faculty: Dr Prabhat Ranjan | Class: Programme Elective

**A. Introduction:** Introduction to networks and digital communications with a focus on Internet protocols: Application layer architectures (client/server, peer-to-peer) and protocols (HTTP-web, SMTP-mail, etc), Transport layer operation: (reliable transport, congestion and flow control, TCP); Network layer operation - (routing, addressing, IPv4 and IPv6), Data Link layer operation (error detection/correction, access control, Ethernet, 802.11, PPP), Layer 2/3 protocols (ATM and MPLS); selected current topics such as: security, multimedia protocols, Quality of Service, mobility, wireless networking, emerging protocols.

**B. Course Outcomes:** At the end of the course, students will be able to

[1759.1] Explain the way protocols currently in use in the internet work and the requirements for designing network protocols.

[1759.2] Capture and analyse network traffic.

[1759.3] Apply the theory of basic network performance analysis.

[1759.4] Analyse the current architecture of the internet and the entities involved with the day to day running of the internet and the process involved with development of policy and new protocols.

[1759.5] Explain and identify security and ethical issues in computer networking.

## C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

**[PO.1]. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

**[PO.2]. Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

**[PO.3]. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

**[PO.4]. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

**[PO.5]. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

**[PO.6]. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

**[PO.7]. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

**[PO.8]. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

**[PO.9]. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

**[PO.10]. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

**[PO.11]. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

**[PO.12]. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

**D. Assessment Plan:**

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	15
	Sessional Exam II (Closed Book)	15
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses any quiz test will have to report to the instructor about the absence in advance. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. There will be no attendance provided for that class.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

**E. SYLLABUS**

Introduction to reference models, data communication, network architecture, basics of OSI, and TCP/IP reference models. Transmission media, FDM, TDM and CDMA, Frame relay and ATM switching, ISDN, Local area network protocols, IEEE standards for LAN. Data link layer design, functions and protocols, link layer, error detection and correction techniques, Ethernet, hubs and switches, PPP, Network layer, Transport layer: connectionless transport-UDP, FTP, Electronic Mail in the internet, P2P file sharing, HTTP, quality of services: ATM Differentiated service model, flow identification, scheduling, factors affecting QOS parameters and service categories, network management, protocol, SNMP, CMIP, concept of traffic and service. Voice and video data, ATM Traffic, Traffic contracting.

**TEXT BOOKS**

1. Andrew S. Tanenbaum, Computer networks, 5<sup>th</sup> edition, PHI, 2010
2. William Stallings, Data and computer communications, 7<sup>th</sup> edition, Prentice Hall of India Pvt. Ltd. 2004

**F. REFERENCE BOOKS**

1. James F. Kurose, Keith W. Ross, Computer networking (A top-down approach featuring the internet), 3<sup>rd</sup> edition, Pearson Education, 2005
2. Charle Kaufman, Radia Perlman, Mike Specines, Uyless Black, Computer networks: Protocols standards and interfaces, Prentice Hall of India Pvt. Ltd. 2010

### 3. Lecture Plan:

LEC NO	TOPICS	Session Outcomes	Mode of Delivery	Corresponding CO	Assessment Mode
1	Introduction and Course Hand-out briefing	To acquaint and clear teachers expectations and understand student expectations	Lecture	NA	NA
2	History and development of computer network	Discussion about the computer networks used at the initial stage.	Lecture	1759.1	Quiz
3,4	Uses of computer networks, Reference models: Layer details of OSI, TCP/IP Models, and Communication between layers.	Applications of computer networks and importance of OSI layers. Why it is essential?	Lecture	1759.1	Quiz Mid term I
5,6	<b>Physical Layer:</b>  Theoretical basis for data communication, Guided transmission media: twisted pair, coaxial, and fiber optics	Fourier analysis, Maximum data rate of a channel	Lecture	1759.1	Mid term I
7,8	Wireless transmission: Radio waves, Bluetooth, Infrared, Virtual LAN.	Electromagnetic spectrum, Public Switched Network	Lecture	1759.1	Mid term I Quiz
9	<b>Data Link Layer:</b> Design Issues	<b>Services provided to the network layer</b>	<b>Lecture</b>	<b>1759.2 1759.3</b>	<b>Quiz</b>
10	Functionalities of DLL	Framing, Design & performance of DLL	Lecture	<b>1759.2 1759.3</b>	Quiz End term
11	Error detection & correction	Error correcting codes	Lecture	<b>1759.2 1759.3 1759.4</b>	Mid term I End term
12	Error detection & correction	Error detection code	Lecture	<b>1759.2 1759.3 1759.4</b>	Mid term I
13	Sliding window, Elementary data link protocols	One-bit sliding window protocol, Protocol using Go-Back-N	Lecture	<b>1759.2 1759.3</b>	Mid term I End term
14	<b>MAC Layer:</b> Channel allocation problems	<b>Static channel allocation, Assumptions of dynamic channel allocation</b>	<b>Lecture</b>	<b>1759.3</b>	<b>Quiz End Term</b>
15,16	ALOHA protocols, Control Access Protocol, CSMA, ETHERNET, Token ring	Collision free protocols, Limited connection protocols	Lecture	<b>1759.3</b>	Mid term II
17	<b>Network Layer:</b> Design Issues	<b>Store and forward switching, Implementation of connectionless services</b>	<b>Lecture</b>	<b>1759.2 1759.3</b>	<b>Mid term II End term</b>
18	Routing Algorithms: Shortest path, Flooding, Distance Vector	Optimality principle	Lecture	1759.4	Quiz End term
19	Congestion Control Algorithms: Approaches to congestion control, Traffic-	Load shedding of networks	Lecture	1759.3	Mid term II

	aware routing, traffic throttling.				
20	Quality of Service: Application requirement, Traffic shaping, Packet scheduling	Students will get to know about the how networks differ and how networks can be connected	Lecture	1759.4	Quiz
21	<b>Transport Layer:</b> Transport services- primitives, Berkeley sockets	<b>Services to upper layer</b>	<b>Lecture</b>	<b>1759.3</b>	<b>Quiz</b>
22	Transport Protocols: Addressing, connection establishment, Error control and flow control.	About the transport layer and their design related issues	Lecture	1759.2	Quiz End term
23	Congestion Control: Bandwidth allocation, regulating the sending issues	Multiplexing, Wireless issues	Lecture	1759.3 1759.4	Mid term II End term
24	<b>TCP:</b> Introduction, Service model	<b>Difference between TCP/IP and OSI Model</b>	<b>Lecture</b>	<b>1759.2</b>	<b>Mid term II</b>
25	TCP Protocol, Segment header, connection establishment	Design issues and how TCP/IP have been improved	Lecture	1759.4	End Term
26	TCP connection management modelling, sliding window	Future of TCP/IP	Lecture	1759.3	Mid term II End term
27	TCP congestion control, performance issues	Timer management	Lecture	1759.3 1759.4	End term
28,29	<b>Application Layer:</b> DNS: Name space, resource records, name servers.	<b>Design related issues</b>	<b>Lecture</b>	<b>1759.2 1759.5</b>	<b>Mid term II</b>
30,31	Electronic Mail: Architecture and services, Message formats, Message transfer	Working of application layer	Lecture	1759.4 1759.5	Mid term II End term
32,33	The World Wide Web: Architecture, applications, HTTP	Static web pages, web search	Lecture	1759.3 1759.5	Mid term II End term
34,35	Streaming video and audio: Digital Audio & Video, streaming stored & Live media	Introduction of real time streaming and conferencing	Lecture	1759.5	Mid term II End term
36, 37	<b>Network Security:</b> Cryptography	<b>Introduction of security systems in network</b>	<b>Lecture</b>	<b>1759.4 1759.5</b>	<b>End term</b>
38	Symmetric Key Algorithms: Data encryption standard	Principles of cryptography	Lecture	1759.4 1759.5	End term
39	CIPHER modes, other CYPHERS	Date encryption standard	Lecture	1759.3 1759.5	End term
40	Cryptanalysis.	Management of network security	Lecture	1759.3 1759.5	End term

#### 4. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MC 1759.1	Explain the way protocols currently in use in the internet work and the requirements for designing network protocols.	1			2										2	
MC 1759.2	Capture and analyse network traffic.		1					2						1		
MC 1759.3	Apply the theory of basic network performance analysis.		2		1		1								1	
MC 1759.4	Analyse the current architecture of the internet and the entities involved with the day to day running of the internet and the process involved with development of policy and new protocols.			3				1						1		
MC 1759.5	Explain and identify security and ethical issues in computer networking.		1			1								2		

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**



# MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Mechatronics Engineering

Course Hand-out

Production and Operation Management| MC 1761 | 3 Credits | 3 0 0 3

Session: July 19 – Nov 19 | Faculty: Dr. Manish Rawat | Class: Program Elective

**A. Introduction:** Operations Management is the systematic approach and control of the processes that transform inputs (e.g. human resources, facilities, materials, Information systems etc.) into finished goods and services. The operations function consists of the core wealth creation processes of a business and helps an organization to efficiently achieve its mission while constantly increasing productivity and quality. This course focuses on the role of operations management as a strategic element of the total organization. We will cover classic and up-to-date tools and concepts used to support operational managerial decisions.

**B. Course Objectives:** At the end of the course, students will be able to

- [1761.1] To gain some ability to recognize use of certain quantitative methods to assist in decision making on operations management and strategy.
- [1761.2] To acquire a working understanding of the roles/functions of production management in the context of business enterprise to enhance entrepreneur skills.
- [1761.3] To develop skills in solving production and operation management problems;
- [1761.4] To recognize, appreciate, and perform the job of a competent production or operation manager.
- [1761.5] To understand the managerial responsibility for Operations, even when production is outsourced.

**C. Program Outcomes and Program Specific Outcomes**

- [PO.1]. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- [PO.2]. **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
- [PO.3]. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
- [PO.4]. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
- [PO.5]. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
- [PO.6]. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice
- [PO.7]. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

- [PO.8]. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices
- [PO.9]. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
- [PO.10]. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
- [PO.11]. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments
- [PO.12]. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
- [PSO.1].** Apply the knowledge of basic sciences, analytical skills and modern computing tools to design, perform and analyse experiments to meet desired goals within the given constraints.
- [PSO.2].** Apply concepts of circuit analysis, analog and digital electronics, controls, electric drives, instrumentation, power systems, machine learning and artificial intelligence to design and automation of mechatronics systems.
- [PSO.3].** Use the principles of solid mechanics, fluid mechanics, and strength of materials, advanced functional materials and manufacturing processes to design, manufacture, and commissioning of mechatronics systems.

#### D. Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	15
	Sessional Exam II (Close Book)	15
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam (Close Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

## E. Syllabus

Forecasting: Importance and uses of forecasting, Type of forecasts, Correlation analysis and Seasonality, Forecast control. Product Development and Design: Factors affecting product development and design, Standardization, Capacity Planning: Factors affecting system capacity, Aggregate Planning: Pure and mixed strategies of aggregate planning, Material Requirement Planning: Product structure tree, Bill of Material. Machine Scheduling: Factors affecting job shop scheduling, Different priority sequencing rules, Determination of mean flow time, average job lateness and average number of jobs in the system, Line balancing, Inventory Control: Economic order quantity, Different inventory control models, Effect of quantity discount, Quality Control: Meaning of Quality, Quality assurance system, Inspection and control of quality; Process control charts, Acceptance sampling, Concept of Six Sigma. Reliability and Maintenance Planning: Constant failure rate and Time-dependent failure rate models for system components; System reliability determination; Types of maintenance. Queuing Model: Introduction, Markov Chains and Markov Processes, Birth-Death Processes, Simple Queueing Models M/M/-/- Queues.

### Text Books:

1. E. Jr. Adam Everett and Ronald J Ebert., *Production and Operations Management*, Prentice Hall of India, New Delhi, 2002.
2. Joseph G. Monks, *Operations Management*, Tata McGraw-Hill, New Delhi, 2004.

### References:

1. Richard B. Chase, Nicholas J. Aquilano and Jacobs F. Roberts, *Production and Operations management*, Tata McGraw-Hill, New Delhi, 1999.
2. Eilon Samuel, *Elements of Production Planning and Control*, Universal Publishing Corporation, Mumbai, 1991.
3. Lee J. Krajewski and Larry P. Ritzman, *Operations Management*, Pearson Education, Singapore, 2005.
4. Gupta Prem Kumar and D. S. Hira, *Operations Research*, S. Chand & Co. Ltd., New Delhi, 2003.

## F. Lecture Plan:

Lecture No.	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction and Course Hand-out briefing		Lecture	NA	NA
2	Introduction of production and operations management.	To gain some ability to recognize use of certain quantitative methods to assist in decision making on operations management and strategy.	Lecture	1761.1	In Class Quiz ( Not Accounted)
3	<b>Forecasting:</b> importance, use and types of forecast technique	To understand the managerial responsibility for Operations, even when production is outsourced..	Lecture	1761.5	In Class Quiz
4	Correlation analysis and seasonality	To gain some ability to recognize use of certain quantitative methods to assist in decision making on operations management and strategy.	Lecture	1761.1	End Term
5	Forecast control	To develop skills in solving production and operation management problems;	Lecture	1761.3	Home Assignment
6	<b>Product Development and Design:</b> an introduction	To acquire a working understanding of the roles/functions of production management in the context of business enterprise.	Lecture	1761.2	End Term
7	Factors affecting product development and design	To understand the managerial	Lecture	1761.5	

		responsibility for Operations, even when production is outsourced.			
8	Product analysis	To acquire a working understanding of the roles/functions of production management in the context of business enterprise.	Lecture	1761.2	In Class Quiz
9	Economic analysis and Standardization	To acquire a working understanding of the roles/functions of production management in the context of business enterprise.	Lecture	1761.2	End Term
10	Flow Diagrams and Man machine charts	To recognize, appreciate, and perform the job of a competent production or operation manager	Lecture	1761.4	Class Quiz
11	<b>Capacity Planning:</b> an introduction	To gain some ability to recognize use of certain quantitative methods to assist in decision making on operations management and strategy.	Lecture	1761.1	Mid Term I
12	Design capacity, System Capacity and System Efficiency	To acquire a working understanding of the roles/functions of production management in the context of business enterprise.	Lecture	1761.2	End Term
13	Factors affecting system capacity	To understand the managerial responsibility for Operations, even	Lecture	1761.5	Class Quiz

		when production is outsourced.			
14	Steps in capacity planning	To recognize, appreciate, and perform the job of a competent production or operation manager	Lecture	1761.4	Mid Term I
15	Decision tree analysis for capacity planning	To acquire a working understanding of the roles/functions of production management in the context of business enterprise.	Lecture	1761.2	End term
16	Breakeven analysis in capacity planning	To acquire a working understanding of the roles/functions of production management in the context of business enterprise.	Lecture	1761.2	Home Assignment
17	<b>Aggregate Planning:</b> an introduction	To recognize, appreciate, and perform the job of a competent production or operation manager	Lecture	1761.4	Class Quiz
18	Pure and mixed strategies of aggregate planning	To gain some ability to recognize use of certain quantitative methods to assist in decision making on operations management and strategy.	Lecture	1761.1	Mid Term I
19	<b>MRP:</b> Introduction and its use		Lecture	1761.1	End Term
20	Product structure tree, MRP inputs & outputs, MRP logic	To recognize, appreciate, and perform the job of a competent production or	Lecture	1761.4	Class Quiz

		operation manager			
21	<b>Line balancing:</b> Meaning and determination of cycle time	To recognize, appreciate, and perform the job of a competent production or operation manager	Lecture	1761.4	Mid Term I
22	Theoretical minimum number of workstations		Lecture	1761.1	End Term
23	<b>Job Shop Scheduling:</b> an introduction and its importance	To gain some ability to recognize use of certain quantitative methods to assist in decision making on operations management and strategy.	Lecture	1761.1	Class Quiz
24	Factors affecting job shop scheduling		Lecture	1761.1	Mid Term I
25	Index method,	To recognize, appreciate, and perform the job of a competent production or operation manager	Lecture	1761.4	End Term
26	Priority sequencing rules	To recognize, appreciate, and perform the job of a competent production or operation manager	Lecture	1761.4	Class Quiz
27	FCFS and numerical		Lecture	1761.1	End Term
28	SPT and numerical examples	To recognize, appreciate, and perform the job of a competent production or operation manager	Lecture	1761.4	Class Quiz
29	EDD and numerical examples	To recognize, appreciate, and perform the job of a competent	Lecture	1761.4	Mid Term II

		production or operation manager			
30	Average job lateness	To develop skills in solving production and operation management problems;	Lecture	1761.3	End Term
31	Average number of jobs in the system	To develop skills in solving production and operation management problems;	Lecture	1761.3	Class Quiz
32	<b>Inventory management:</b> Introduction	To gain some ability to recognize use of certain quantitative methods to assist in decision making on operations management and strategy.	Lecture	1761.1	Mid Term II
33	Classification of inventories, Economic order quantity	To gain some ability to recognize use of certain quantitative methods to assist in decision making on operations management and strategy.	Lecture	1761.1	End Term
34	Inventory control models	To develop skills in solving production and operation management problems;	Lecture	1761.3	Class Quiz
35	Effect of quantity discount	To develop skills in solving production and operation management problems;	Lecture	1761.3	Mid Term II
36	Quality Control: Meaning of Quality, Quality assurance system,	To develop skills in solving production and operation	Lecture	1761.3	End Term

		management problems;			
37	Inspection and control of quality; Process control charts,	To develop skills in solving production and operation management problems;	Lecture	1761.3	Class Quiz
38	Acceptance sampling, Concept of Six Sigma.	To develop skills in solving production and operation management problems;	Lecture	1761.3	Mid Term II
39	Reliability and Maintenance Planning:		Lecture	1761.1	End Term
40	Constant failure rate and Time-dependent failure rate models for system components;	To develop skills in solving production and operation management problems;	Lecture	1761.3	Class Quiz
41	System reliability determination;	To develop skills in solving production and operation management problems;	Lecture	1761.3	End Term
42	Types of maintenance.	To acquire a working understanding of the roles/functions of production management in the context of business enterprise;	Lecture	1761.2	Class Quiz
43	Queuing Model: Introduction,	To develop skills in solving production and operation management problems;	Lecture	1761.3	End Term
44	Markov Chains and Markov Processes,	To develop skills in solving production and operation	Lecture	1761.3	Class Quiz

		management problems;			
45	Birth-Death Processes,	To develop skills in solving production and operation management problems;	Lecture	1761.3	End Term
46	Simple Queueing Models M/M/-/-Queues.	To develop skills in solving production and operation management problems;	Lecture	1761.3	Class Quiz
47	Case Study-I		Lecture		
48	Case Study-II		Lecture		

**G. Course Articulation Matrix: (Mapping of COs with POs)**

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MCI761.1	To gain some ability to recognize use of certain quantitative methods to assist in decision making on operations management and strategy.	3							1					1		3
MCI761.2	To acquire a working understanding of the roles/functions of production management in the context of business enterprise;		2	2								2		1		3
MCI761.3	To develop skills in solving production and operation management problems;				2	2								1		3
MCI761.4	To recognize, appreciate, and perform the job of a competent production or operation manager						2		2	3				1		3
MCI761.5	To understand the managerial responsibility for Operations, even when production is outsourced,			1						1	1			1		3

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**





# MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Mechatronics Engineering

Course Hand-out

Virtual Instrumentation | MCI762 | 3 Credits | 3 0 0 3

Session: July 19 – Nov 19 | Faculty: Kumar Gaurav | Class: Program Elective

**A. INTRODUCTION:** The objective of this course is to introduce the concept of virtual instrumentation and to develop basic VI programs using loops, case structures etc. including its applications in image, signal processing and motion control.

**B. COURSE OUTCOMES:** At the end of the course, students will be able to

**[MCI762.1]** To Describe about virtual instrumentation and introduce about VI tool sets.

**[MCI762.2]** To demonstrate the working of Lab VIEWs and learn its basic programming concepts: To enhance enterprenuer skills

**[MCI762.3]** To get introduced to VI programming techniques.

**[MCI762.4]** To Describe Data Acquisition System Components- To enhance employability skills

**[MCI762.5]** Acquaint students about the applications of Virtual instrumentation

## C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

**[PO.1].Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

**[PO.2].Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**[PO.3].Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations..

**[PO.4].Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

**[PO.5]. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

**[PO.6].The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**[PO.7]. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

**[PO.8]. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices

**[PO.9]. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**[PO.10].Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**[PO.11] Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

**[PO.12]. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

**[PSO.1].** Apply the knowledge of basic sciences, analytical skills and modern computing tools to design, perform and analyse experiments to meet desired goals within the given constraints.

**[PSO.2].** Apply concepts of circuit analysis, analog and digital electronics, controls, electric drives, instrumentation, power systems, machine learning and artificial intelligence to design and automation of mechatronics systems.

**[PSO.3].** Use the principles of solid mechanics, fluid mechanics, strength of materials, advanced functional materials and manufacturing processes to design, manufacture, and commissioning of mechatronics systems.

#### Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	15
	Sessional Exam II (Closed Book)	15
	1. Case Study 2. Lab Practical	30
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment	There are situations where a student may have to work in home. Although these works are not graded with marks. However, a student is expected	

(Formative)

to participate and perform these assignments with full zeal since the activity classroom participation by a student will be assessed and marks will be awarded.

## SYLLABUS:

**Basics of Virtual Instrumentation**-Historical Perspective, Need/Advantages of VI, Defining VI, Block Diagram & Architecture of VI, Data flow techniques, Graphical Programming, Comparison with Conventional Programming. **VI Programming Techniques**-VIs and SUBVIs, Loops and Charts, Arrays, Clusters, Graphs, Case/Sequence Structures, Formula nodes, Local & Global Variables, Strings & File Input. **Data Acquisition Basics with VI**-ADC/DAC, DI/O, Counters/Timers, PC Hardware Structures, and Timing interrupts, DMA, Software & Hardware Installations. **Use of Analysis Tool**-Fourier Transform, Power Spectrum, Correlation Methods, Fourier transform – Power spectrum – Correlation – Windowing and filtering tools – Simple temperature indicator – ON/OFF controller – PID controller – CRO emulation –Simulation of a simple second order system, CASESTUDY using LABVIEW based projects.

### Primary References:

LabVIEW based Advance Instrumentation, P.Surekha, S.Sumathi.

Virtual Instrumentation Using LabVIEW, Jovitha Jerome

Gary Johnson, 'Lab view graphical programming', II Ed., McGraw Hill, 1997

Lisa K Wells & Jeffrey Travels, 'Lab view for everyone', Prentice Hall, 1997

B. Mihura, LabVIEW for Data Acquisition, Prentice Hall, 2001

R. Bishop, LabVIEW 8 Student Edition, Prentice Hall, 2006

### Secondary References:

B.E. Paton, Sensors, Transducers and LabVIEW, Prentice Hall, 1999

J. Travis, Internet Applications in LabVIEW, Prentice Hall, 2000

### Lecture Plan:

Lec. No	Topics	Session Objective	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction and Course Hand-out briefing	To acquaint and clear teachers expectations and understand student expectations	Lecture	NA	NA
2	Historical perspective , Need of VI, Advantages of VI, Define VI	To understand the definition of few terms	Lecture	COI	In Class Quiz ( Not Accounted) Midterm I End Term
3,4	Block Diagram and Architecture of VI	To understand the basic architecture of the VI	Lecture	COI	In Class Quiz Mid Term I

					End Term
5,6	Data Flow techniques	Study different technique to be used for data flow programming	Group Activity	CO2	Home Assignment Mid Term 1 End Term
7-10	Graphical programming in data flow Comparison with conventional programming	Study the comparison between traditional and graphical programming	Lecture,	CO2	Home Assignment Mid Term 1 End Term
11	Introduction to LABVIEW Software	To acquaint the students about LABVIEW software	Lab Activity	CO3	Home Assignment Class Quiz Mid Term 1 End Term
12-14	VIS and sub-VIS Loops & charts, arrays, clusters, graphs	To acquaint the students about the VIS and SUBVIS	Lecture	CO3 & CO4	Seminar Mid Term 1 End Term
15,16	Continued , Practice in LABVIEW Software	To learn the programming on the software	Lab Activity	CO3 & CO4	Seminar Mid Term 2 End Term
17	Case & sequence structures	To understand the structures used in LABVIEW software	Lecture	CO3 & CO4	Class Quiz Mid Term 2 End Term
18-19	Formula nodes, local and global variable	To study about the formula node and different variables to be used in Software	Lecture	CO3 & CO4	Class Quiz, Case Study Mid Term 2 End Term
20	Practice	To familiarise the techniques used in LABVIEW software	Lab Activity	CO3 & CO4	Class Quiz Mid Term 2 End Term
21	Graphical programming in data flow	To know the concept of graphical programming	Lecture	CO2, CO3 & CO4	Case Study Mid Term 2 End Term
22-24	String & file input and output	To understand the use of different strings used in LABVIEW software	Lecture	CO 4	Class Quiz Mid Term 2 End Term
25	Practice	To learn the different concepts using LABVIEW software	Lab Activity	CO 4, CO5 & CO6	Class Quiz Mid Term 2 End Term
26	DAQ Configuration	Learn different Data Acquisition System concepts.	Lecture	CO5	Class Quiz Mid Term 2 End Term
27-30	DIO techniques , ADC/DAC, DI/O,	Learn different Data Acquisition	Lecture	CO5	Class Quiz

	Counters/Timers	System concepts.			End Term
31-32	windowing & filtering , Application in Process Control projects	To develop real time application in process control	Lecture	CO 5 & CO6	Home Assignment End Term
33-35	Fourier transforms, Power spectrum	To learn signal processing techniques used in LABVIEW	Lecture	CO 5	Class Quiz End Term
36	Major Equipments- Oscilloscope, Digital Multimeter	To use VI for different applications	Lecture	CO 6	Class Quiz
37	Revision	NA	NA, Flipped Classroom	NA	NA

# I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES			P S O 4
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PS O 3	
MC 1762.1	To Describe about virtual instrumentation and introduce about VI tool sets.	2	2	2	2	2		1						2	2		
MC 1762.2	Learn the basic programming concepts in Lab VIEW	3	2		2	3	2	1						2	2		1
MC 1762.3	To get introduced to VI programming techniques.	3	2		2	1		1						3	3		
MC 1762.4	To Describe Data Acquisition System Components.	3	3	3	2	2		1						3	3		
MC 1762.5	Acquaint students about the applications of Virtual instrumentation	3			2	2		1						3	3		

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation