MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

DEPARTMENT OF MECHANICAL ENGINEERING

PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

B.Tech – Mechanical Engineering | Academic Year: 2018-19

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.

PROGRAM SPECIFIC OUTCOMES

[PSO.1]. Modelling & Analysis: Model and analyze mechanical engineering components using advanced software.

[PSO.2]. Alternative fuels: Analyze performance of I. C. engines attributed to alternate fuels.

[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

PROGRAM ARTICULATION MATRIX

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
I&II	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	-	-
	ME1130	-	-	1	2	-	-	2	1	-	-	1	-	-	-	-
	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	-	-
	EN1111	1	1	-	-	-	-	-	1	-	-	-	1	-	-	-
	ES 1103	3	3	3	2	-	2	2	-	-	-	-		-	1	-
	HS 1102	-	-	3	-	-	3	2	1	-	-	-	3	-	-	-
III	EO 1323	-	-	-	-	-	1	-	-	2	-	2	3	-	-	2
	MA 1313	2	-	-	1	1	-	-	-	-	2	-	-	1	2	1
	ME 1301	3	3	3	3	3	3	-	2	3	-	2	1	-	-	3
	ME 1302	3	2	2	2	-	1	1	-	-	-	-	2	1	-	-
	ME 1303	3	3	2	-	2	2		-	-	-	-	2	3	-	1
	ME 1304	3	3	3	-	-	-	-	-	-	-	-	1	2	-	-
IV	MA 1410	2	-	-	1	1	-	-	-	-	2	-	-	1	2	1
	ME 1401	3	2	2	2	2	2	-	2	3	1	2	1	-	-	-
	ME 1402	3	2	3	-	2	-	1	-	-	-	-	1	2	-	-
	ME 1403	3	2	-	1	1	-	-	-	-	-	-	-	-	-	-
	BB 1101	-	-	-	-	-	1	1	2	1	2	-	2	-	-	3
V	BB 1540	3	3	3	2	1	-	1	-	-	1	-	1	2	1	1
	ME 1506	3	3	3	2	-	3		-	-	-	-		2	-	-
	ME 1507	3	2	1	2	-	1	1	-	-	-	-	2	1	-	-
	ME 1508	3	3	3	3	2	3	3	3	3	-	2	3	-	-	2
	ME 1553	1	1	2	2	2	-	-	1	2	1	3	1	-	-	-
	ME 1555	3	3	3	3		3	3		1	-	-	2	-	-	2
	ME1556	3	2	1	1	2	2	1	1	2	2	1	2	2	3	3
VI	ME1605	3	3	3	3	1	1	-	-	-	-	-	-	1	-	-
	ME1606	3	2	3	3	3	-	2	-	-	-	-	2	-	3	2
	ME1607	3	2	2	2	2	2	1	-	-	-	-	-	1	-	1
	ME1653	3	2	2	2	2	2	-	2	3	1	2	-	-	-	-
	ME1655	2	-	3	-	-	-	-	-	-	-	-	-	-	-	2
	ME1656	3	2	-	1	-	2	3	-	-	-	-	-	3	-	-
	ME1657	3	2	-	1	-	2	1	-	-	-	-	-	-	-	3
	ME1658	1	3	3	2	3	2	1	-	2	2	2	1	1	-	-
	ME1659	1	1	2	-	2	-	-	-	-	-	-	-	-	-	-
	ME1660	3	2	2	2	2	2	-	2	3	1	2	-	-	-	-
VII	ME1706	2	2	2	2	2	2	1								
	ME 1707	3	2		2	1								3		
	ME 1708	3	2	2	1	2	2	1			1			1	2	
	ME 1709	3	3	1	2								3	2		
	ME1757	3	2	3	2	1	2	2			1	2			1	

	ME1758	2	3	3		3	2	2		2				2		2
	ME1759	3	3			1	1						2			

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Physics

Course Hand-out

Engineering Physics | PY 1101 | 5 Credits | 3 1 1 5

Session: July 18 – May 19 | Faculty: Dr. Saikat | Class: B.Tech First Year, Semester- I/II

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

[PY1101.1]. Understand the wide range of diversity in science and technology with the help of knowledge of basic Physics along with practical approach of Engineering Physics.

[PY1101.2]. Explain various processes involved in understanding the nature of light.

[PY1101.3]. Identify the problems and applications of Quantum mechanics.

[PY1101.4]. Impart the knowledge of empirical laws based on Solid state Physics and Atomic and Molecular Physics.

[PY1101.5]. Achieve perfectness in experimental skills and the study of practical applications in Physics.

[PY1101.6]. Develop skills to impart practical knowledge in real time solution.

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 under - standing of the limitations.

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PROGRAM SPECIFIC OUTCOMES:

[PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software
[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels
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D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Open Book)	15
	Sessional Exam II (Open Book)	15
	In class Quizzes (Accumulated and Averaged)	10
End Term Exam (Summative)	End Term Exam (Open Book)	40
Lab Evaluation	Regular Lab Performance & viva voce	20
	Total	100
Attendance (Formative)	A minimum of 75% attendance separately for each component (Theory lectures and Practical's) 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, interference from thin films, 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 speed, ground speed), the uncertainty principle.

QUANTUM MECHANICS : An interpretation of quantum mechanics, Wave function and its significance, Schrodinger equation, particle in a box, Particle in a well of finite height (qualita tive), Tunnelling 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-Types, Moseley 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 Super conductors, Meisner effect, BCS Theory (Introductory) and applications of Superconductivity.

F. TEXT BOOKS

T1. Halliday, Resnick, Krane, PHYSICS, Volume 2, 5th edition, John Wiley & Sons, Inc, 2011 *(For Optics)*
T2. Beiser & Mahajan, Modern Physics, Mc Graw Hill, 6th edition., 2009 *(For Quantum Physics, Quantum Mechanics, Atomic Physics, Solid State Physics)*

G. REFERENCE BOOKS

R1.Serway & Jewett, PHYSICS for Scientists and Engineers with Modern Physics; Volume 2,6 th edition,

H. 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	**PY1101.1**	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	**PY1101.1 & 1101.2**	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	**PY1101.2**	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	**PY1101.2**	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	**PY1101.2**	Class Quiz – I Home Assignment - I Mid Term I End Term
6	TUTORIAL:1		Activity (Think Pair Share)	**PY1101.2**	
7	Interference in wedge shaped air film	Understand the concept of interference in wedge shaped films and	Lecture	**PY1101.2**	Class Quiz – I Home Assignment - I Mid Term I

		introduction to Newton's ring			End Term
8	Newton's rings – theory and experiment	Describe the Newton's ring experiment and develop the theory of Newton's ring	Lecture	**PY1101.2**	Class Quiz – 1 Home Assignment-1 Mid Term I End Term
9	**TUTORIAL: 2**		Activity (Think Pair Share)	**PY1101.2**	
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	**PY1101.2**	Class Quiz – 1 Home Assignment -1 Mid Term I End Term
12	**TUTORIAL: 3**		Activity (Think Pair Share)	**PY1101.2**	
13-14	Diffraction and wave theory of light, Fraunhoffer diffraction at single slit – theory and intensity distribution	Introduction to diffraction and understand the difference between Fraunhoffer and Fresnel diffraction	Lecture, Activity	**PY1101.2**	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	**PY1101.2**	Class Quiz – 2 Home Assignment - 2 Mid Term I End Term
17	**TUTORIAL:4**		Activity (Think Pair Share)	**PY1101.2**	
18	Fraunhoffer diffraction at double slit – theory (Qualitative approach only) and intensity distribution	Qualitatively develop the formula for intensity distribution in double slit diffraction	Lecture	**PY1101.2**	Class Quiz – 2 Home Assignment - 2 Mid Term I End Term
19	Fraunhoffer diffraction at multiple slit – theory and intensity distribution, Diffraction grating	Understand the multiple slit diffraction pattern and diffraction grating	Lecture	**PY1101.2**	Class Quiz – 3 Home Assignment- 2 Mid Term I End Term
20	**TUTORIAL:6**		Activity (Think Pair Share)	**PY1101.2**	
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	**PY1101.2**	Class Quiz – 3 Home Assignment-2 Mid Term I End Term
22	**TUTORIAL:7**		Activity (Think Pair	**PY1101.2**	

			Share)		
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	**PY1101.2**	Class Quiz – 3 Home Assignment - 3 Mid Term I End Term
25	**TUTORIALS: 8**		Activity (Think Pair Share)	**PY1101.2**	
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	**PY1101.1 & 1101.3**	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	**PY1101.1 & 1101.3**	Class Quiz – 4 Home Assignment - 4 Mid Term II End Term
30	**TUTORIAL:9**		Activity (Think Pair Share)	**PY1101.3**	
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	**PY1101.1 & 1101.3**	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 Principle (Statement and expression only) and its Physical significance	Understand the Group Velocity and Phase Velocity and the concept of Uncertainty Principle	Flipped Classroom, Lecture	**PY1101.3**	Class Quiz – 5 Home Assignment - 5 Mid Term II End Term
34	**TUTORIAL: 10**		Activity (Think Pair Share)	**PY1101.3**	
35	An Interpretation of Quantum mechanics, Wave function and its physical significance, SchrŐdinger wave	Introduction to wave function and Schrodinger wave equation	Lecture	**PY1101.3**	Class Quiz – 5 Home Assignment - 5 Mid Term II End Term

	equation				
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	**PY1101.3**	Class Quiz – 6 Home Assignment - 5 Mid Term II End Term
37	**TUTORIAL: 11**		Activity (Think Pair Share)	**PY1101.3**	
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	**PY1101.3**	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	**PY1101.3**	Class Quiz – 6 Home Assignment - 5 Mid Term II End Term
41	**TUTORIAL: 12**		Activity (Think Pair Share)	**PY1101.3**	
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	**PY1101.1 & 1101.4**	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	**PY1101.4**	Class Quiz – 7 Home Assignment - 6 End Term
46	**TUTORIAL: 13**		Activity (Think Pair Share)	**PY1101.4**	
47	Lasers-Spontaneous and stimulated transitions, Population inversion and metastable state,	Understand the lasers and the related optical phenomena.	Lecture	**PY1101.4**	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	**PY1101.4**	Class Quiz – 7 End Term
50	**TUTORIAL: 14**		Activity (Think Pair Share)	**PY1101.4**	
51	Band Theory of solids, Electrical conduction in Metals, Insulators, and	Understand qualitatively the band theory of solids	Lecture	**PY1101.4**	Class Quiz – 8 End Term

	Semiconductors				
52-53	Superconductivity: Type-I and Type- II Superconductivity, Meisner effect	Introduction to super conductivity and superconductors and the related phenomena	Lecture	**PY1101.4**	Class Quiz – 8 End Term
54	**TUTORIAL: 15**		Activity (Think Pair Share)	**PY1101.4**	
55	BCS Theory (Introductory) and Applications of superconductivity	Qualitatively understand the BCS theory and their applications	Lecture	**PY1101.4**	Class Quiz – 8 End Term
56	**TUTORIAL: 16**		Activity (Think Pair Share)	**PY1101.4**	
LAB SESSIONS	Lab sessions based on different aspects of physics	Experiment and test different aspects of physics related to the theory taught in the class	Lab Sessions	**PY1101.5 & 1101.6**	Experimental results and viva-voce of 14 lab sessions Laboratory End Term Exam

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

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	PSO 4
PY 1101.1	understand the wide range of diversity in science and technology with the help of knowledge of basic Physics along with practical approach of Engineering Physics	2			2			3				3					
PY 1101.2	explain various processes involved in understanding the nature of light																
PY 1101.3	identify the problems and applications of Quantum mechanics		2		3							2					
PY 1101.4	impart the knowledge of empirical laws based on Solid state		2			2					3						

	Physics and Atomic and Molecular Physics																
PY 1101.5	achieve perfectness in experimental skills and the study of practical applications in Physics		2				2			3							
PY 1101.6	develop skills to impart practical knowledge in real time solution				2						3	3					

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

MANIPAL UNIVERSITY JAIPUR

Faculty of Engineering

B.Tech. First Year (All branches)

DEPARTMENT OF MATHEMATICS AND STATISTICS

Course Hand-out

Engineering Mathematics-I|MA1101 | 4 Credits | 3 1 0 4

Session: July –Dec., 2018 | Faculty: Dr. Mohd. Rizwanullah & Dr. Reema Jain | Class: First Year, Semester- I/II

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 subjects.

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

[MA1101.1] Solve the problem on Radius of curvature, Circle and chord of curvature, Asymptotes, curve tracing for Cartesian and polar curves.

[MA1101.2] Demonstrate the understanding of the derivatives of functions of several variables and it will enhance the problem solving skills.

[MA1101.3] Optimize the functions of several variables using Hessian method and Lagrangian method and further will improve the logical skills hence Employability.

[MA1101.4] Use matrices, determinants and techniques for solving systems of linear equations in the different areas of Linear Algebra

[MA1101.5] Solve Eigen value problems, Applications of integral calculus: area and length of curves and volume of solid of revolution of simple curves.

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.

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PROGRAM SPECIFIC OUTCOMES:

[PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software
[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels
[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Open Book)	15
	Sessional Exam II (Open 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

Differential Calculus: Radius of curvature, Circle and chord of curvature, Asymptotes, curve tracing for Cartesian and polar curves. Taylor's theorem for a function of one variable. Taylor's and Maclaurin's expansion of functions. **Partial Differentiation**: Euler's theorem on homogeneous functions, total derivative, derivatives of composite and implicit functions, Taylor's theorem for a function of two variables, extreme values of a function of two variables, Lagrange's method of undetermined multipliers, Errors and approximations. **Integral Calculus**: Reduction formulae. Applications of integral calculus: area and length of curves and volume of solid of revolution of simple curves. **Matrices**: Elementary transformations, Inverse and rank of a matrix by elementary transformation,

Consistency and solution of system of simultaneous equations, eigenvalues, eigenvectors, Caley -Hamilton theorem, diagonalization of a matrix

F. Text Books

T1. S. Pal & S. C. Bhunia, "Engineering Mathematics", Oxford University Press, 2015.

T2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, Delhi, 2006. T3.
T3.B. V. Ramana, "Higher Engineering Mathematics", McGraw Hill, 2014.

G. Reference Books

R1. E. Kreyszig, "Advanced Engineering Mathematics", Wiley India Edition,

2006.

R2. B. Ram, "Engineering Mathematics", Vol. I & II, Pearson, 2012.

R3. S. Narayan, "Differential Calculus", Shyam Lal Charitable Trust, Delhi, 2002.

R4. S. Narayan, "Integral Calculus", S. Chand & Co., Delhi, 2005

A. Lecture Plan:

Lecture No.	Description of the Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
	Curvature & Asymptotes:				
1	Introduction, Definition, Radius of curvature (Cartesian Coordinate)	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	MA110 1.1	Quizzes, Two Sessional, End Term Examination
2	Radius of curvature (Parametric Coordinate)	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	MA110 1.1	Quizzes, Two Sessional, End Term Examination
3	Radius of curvature (Polar Coordinate)	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	MA110 1.1	Quizzes, Two Sessional, End Term Examination
4	**Tutorial Class**	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	MA110 1.1	Quizzes, Two Sessional, End Term Examination
5	Circle of curvature	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	MA110 1.1	Quizzes, Two Sessional, End Term Examination
6	Chord of curvature	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	MA110 1.1	Quizzes, Two Sessional, End Term Examination

7	Asymptotes (Parallel)	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	MA110 1.1	Quizzes, Two Sessional, End Term Examination
8	Asymptotes (Inclined)	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	MA110 1.1	Quizzes, Two Sessional, End Term Examination
9	**Tutorial Class**	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	MA110 1.1	Quizzes, Two Sessional, End Term Examination
	Curve Tracing				
10	Procedure for tracing Cartesian curves	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	MA110 1.1	Quizzes, Two Sessional, End Term Examination
11	Problems based on above topic	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	MA110 1.1	Quizzes, Two Sessional, End Term Examination
12	Procedure for tracing polar curves	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	MA110 1.1	Quizzes, Two Sessional, End Term Examination
13	Problems based on above topic	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	MA110 1.1	Quizzes, Two Sessional, End Term Examination

14	**Tutorial Class**	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	MA110 1.1	Quizzes, Two Sessional, End Term Examination
15	Taylor's theorem for a function of one variable	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	MA110 1.2	Quizzes, Two Sessional, End Term Examination
16	Taylor's and Maclaurin's expansion of functions	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	MA110 1.2	Quizzes, Two Sessional, End Term Examination
17	**Tutorial Class**	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	MA110 1.2	Quizzes, Two Sessional, End Term Examination
	Partial Differentiation				
19	Introduction & problems	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	MA110 1.2	Quizzes, Two Sessional, End Term Examination
20	Euler's theorem on homogeneous functions	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	MA110 1.2	Quizzes, Two Sessional, End Term Examination
21	**Tutorial Class**	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	MA110 1.2	Quizzes, Two Sessional, End Term Examination

22	Total derivative	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	MA110 1.2	Quizzes, Two Sessional, End Term Examination
23	Derivatives of composite and implicit functions	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	MA110 1.2	Quizzes, Two Sessional, End Term Examination
24	Change of variables	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	MA110 1.2	Quizzes, Two Sessional, End Term Examination
25	**Tutorial Class**	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	MA110 1.2	Quizzes, Two Sessional, End Term Examination
27	Taylor's theorem for a function of two variables	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	MA110 1.2	Quizzes, Two Sessional, End Term Examination
28	**Tutorial Class**	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	MA110 1.2	Quizzes, Two Sessional, End Term Examination
29	Extreme values of a function of two variables	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	MA110 1.3	Quizzes, Two Sessional, End Term Examination
30	Lagrange's method of undetermined	Identify, formulate, apply	Lecture,	MA110 1.3	Quizzes, Two Sessional, End

	multipliers	appropriate techniques, professional ethics, Communicate effectively & life-long learning	Discussion & Examples		Term Examination
31	Errors and approximations	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	MA110 1.3	Quizzes, Two Sessional, End Term Examination
32	**Tutorial Class**	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	MA110 1.3	Quizzes, Two Sessional, End Term Examination
	Matrices:				
33	Matrices, elementary column and row transformations	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	MA110 1.4	Quizzes, Two Sessional, End Term Examination
34	Inverse of a matrix by elementary transformations	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	MA110 1.4	Quizzes, Two Sessional, End Term Examination
35	Rank of a matrix by elementary transformations	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	MA110 1.4	Quizzes, Two Sessional, End Term Examination
36	**Tutorial Class**	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	MA110 1.4	Quizzes, Two Sessional, End Term Examination
37	Solution of systems of linear equations,	Identify, formulate, apply	Lecture,	MA110 1.4	Quizzes, Two Sessional, End

	consistency	appropriate techniques, professional ethics, Communicate effectively & life-long learning	Discussion & Examples		Term Examination
39	Solution by Gauss elimination	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	MA110 1.4	Quizzes, Two Sessional, End Term Examination
40	**Tutorial Class**	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	MA110 1.4	Quizzes, Two Sessional, End Term Examination
41	Cayley-Hamilton theorem, Eigenvalues	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	MA110 1.5	Quizzes, Two Sessional, End Term Examination
42	Eigenvectors	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	MA110 1.5	Quizzes, Two Sessional, End Term Examination
43	Diagonalization of a square matrix	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	MA110 1.5	Quizzes, Two Sessional, End Term Examination
44	**Tutorial Class**	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	MA110 1.5	Quizzes, Two Sessional, End Term Examination
	Integral Calculus:				
46	Reduction formulae	Identify, formulate, apply	Lecture,	MA110 1.6	Quizzes, Two Sessional, End

		appropriate techniques, professional ethics, Communicate effectively & life-long learning	Discussion & Examples		Term Examination
47	Area of simple curves	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	MA110 1.6	Quizzes, Two Sessional, End Term Examination
48	**Tutorial Class**	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	MAMA 1101.6	Quizzes, Two Sessional, End Term Examination
49	Lengths of simple curves	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	MA110 1.6	Quizzes, Two Sessional, End Term Examination
51	Volume of revolution of simple curves	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	MA110 1.6	Quizzes, Two Sessional, End Term Examination
52	**Tutorial Class**	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	MA110 1.6	Quizzes, Two Sessional, End Term Examination

B. 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~~
MA1101.1	Solve the problem on Radius of curvature, Circle and chord of curvature, Asymptotes, curve tracing for Cartesian and polar curves.	3	2	3	1			1			1		1			
MA1101.2	Demonstrate the understanding of the derivatives of functions of several variables and it will enhance the problem solving skills.	3	2	1	2	1										
MA1101.3	Optimize the functions of several variables using Hessian method and Lagrangian method and further will improve the logical skills hence Employability.	3	3	2	2						1		1			
MA1101.4	Use matrices, determinants and techniques for solving systems of linear equations in the different areas of Linear Algebra	3	2	2	2	1		1					1			
MA1101.5	Solve Eigen value problems, Applications of integral calculus: area and length of curves and volume of solid of revolution of simple curves	2	3	1	1	1							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
Environmental Studies | ES 1101 | 3 Credits | 3 0 0 3
Session: January – May 2019 | Faculty: Dr. M. Prabhu Inbaraj | Class: First Year, Semester- I/II

A. Introduction: This course is offered to B. Tech. first year students to make them aware of the importance of our natural environment. The course offers insights into the basics of environment, its components, functions; impacts of natural and anthropogenic activities on environment; methods to tackle such environmental issues. Further, this course emphasises on the significance of life on earth and thus, the need for its protection. Overall, this course is aimed to sensitise students to realize links between the natural and man-made environment.

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

[ES1101.1]. Apply the fundamental knowledge of environment, ecology and ecosystem to save the environment for sustainable development.

[ES1101.2]. 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.

[ES1101.3]. Develop the skill of the technique / procedures to predict / qualitatively assess the reduction in the environmental impact for sustainable development.

[ES1101.4]. 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.

[ES1101.5]. 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.

PROGRAM SPECIFIC OUTCOMES:

[PSO.1]. Modelling & Analysis: Model and analyze mechanical engineering components using advanced software.

[PSO.2]. Alternative fuels: Analyze performance of I. C. engines attributed to alternate fuels.

[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Open Book)	15
	Sessional Exam II (Open 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

Introduction to Environmental Studies; Multidisciplinary Nature of Environmental Studies, Scope and importance, concept of sustainability and sustainable development; spheres of the earth; structure of atmosphere.

Ecosystems; concept, structure and function, energy flow in an ecosystem, food chain, food webs and ecological succession, Forest, Grassland, Desert and Aquatic (Ponds, Streams, Lakes, River, Oceans, Estuaries) ecosystem.

Natural Resources (Renewable & Non Renewable Resources); Land Resources and land use change, Land degradation, soil erosion and desertification; Deforestation; Causes and impacts. Water; Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state). Energy resources; Renewable and non- renewable energy sources, use of alternate energy sources, growing energy needs.

Biodiversity and Conservation; Genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots, threats to biodiversity; Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity; *In-situ* and *ex-situ* conservation of biodiversity. Ecosystem and biodiversity services; Ecological, economic, social, ethical, aesthetic and Informational value.

Environmental Pollution; Environmental Pollution; type, causes, effects, and controls; Air, Water, Soil and Noise pollution, Nuclear hazards and human health risks, ill effects of fireworks, Solid waste management; control measures of urban and industrial waste, pollution case studies.

Environmental Policies and Practices; Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture, Environment laws; Environmental Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act; International agreements; Montreal and Kyoto protocols and Convention on Biological Diversity (CBD). Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

Human Communities and the Environment; Human population growth; impact on environment, human health and welfare, Resettlement and rehabilitation of project affected persons; case studies, Disaster management; flood, earthquake, cyclone and landslides. Environmental movements; Chipko, Silent valley, Bishnois of Rajasthan, Environmental ethics; Role of Indian and other religions and cultures in

environmental conservation, Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi), Environmental Impact Assessment (EIA).
Field Work and field visits.

F. TEXT BOOKS

T1. Bharucha, E. (2013). Text book of Environmental Studies for undergraduate courses, Universities Press, Hyderabad, 2nd Edition

T2. Carson, R. (2002). Silent Spring. Houghton Mifflin Harcourt.

T3. De, A. K. and De, A. K. (2007). Environmental Studies, New Age International Publishers, New Delhi.

T4. Gadgil, M. and Guha, R. (1993). This Fissured Land; An Ecological History of India. University of California, Press.

T5. Groom, Martha J., Gary, K. Meffe and Carl Ronald Carroll (2006). Principles of Conservation Biology. Sunderland; Sinauer Associates.

T6. Grumbine, R. Edward and Pandit, M. K. (2013).Threats from India's Himalaya dams. Science, 339; 36-37.

T7. Rajagopalan, R. (2016). Environmental Studies; From Crisis to Cure, Oxford University Press.

T8. Singh, J. S., Singh, S. P. and Gupta, S. R. (2014). Ecology, Environmental Science and Conservation.
S. Chand Publishing, New Delhi.

G. REFERENCE BOOKS

R1. Molles, M. C. (2015). Ecology: Concepts and Applications. McGraw Hill Higher Education, 7th Edition, 592 P.

R2. Chiras, D. D. (2014). Natural Resource Conservation: Management for a Sustainable Future. Pearson .

Lecture Plan:

LEC NO	TOPICS
1	**Multidisciplinary Nature of Environmental Studies:** Scope of environmental studies, a multidisciplinary view, Importance of environmental studies
2	**Ecosystems and Environment:** Spheres of the earth: atmosphere, lithosphere, hydrosphere, biosphere
3	**Structure of the atmosphere:** troposphere, stratosphere, mesosphere, thermosphere, exosphere
4	**Ecology**: structure and function of the ecosystem
5	**Bio-geochemical cycles:** Nitrogen, Carbon
6	**Bio-geochemical cycles:** Sulphur, Phosphorous
7	**Ecological succession**
8	**Natural resources (Renewable & Non Renewable Resources):** Water Resources
9	**Energy Resources**: Conventional and non-conventional
10	**Energy Resources:** Conservation and Management
11	Forest Resources
12	Land Resources
13	**Biodiversity and its Conservation:** Biodiversity: Importance of biodiversity
14	Threats to biodiversity
15	Factors affecting biodiversity
16	Conservation of biodiversity
17	**Environmental pollution and control** : **Air pollution**: sources of air pollution and classification of air pollutants
18	Primary and secondary air pollutants
19	**Fireworks:** Chemical used, toxic fall out and their persistent in soil and water, Its ill effects on air quality pertaining to gaseous and particulate matter, Health hazards prevention and Control
20	**Water pollution:** Sources of water pollution, water quality standards (physical, chemical and biological characteristics of water quality parameters)
21	Effects of water pollution and Water Borne Diseases and its control
22	Basic water treatment process (filtration, sedimentation and overview of treatment plant)
23	**Soil pollution:** sources, effects and control of soil pollution
24	**Noise pollution:** sources, effects and control of noise pollution
25	**Solid waste management:** sources, characteristics
26	**Solid waste management:** control measures of urban and industrial wastes
27	Hazardous Waste – Environmental problems and health risks
28	**Environmental impact assessment(EIA):** Methodology and importance
29	**Social Issues and Environment:** Environmental concerns: urbanization, industrialization, agricultural revolution and their impact on environment
30	**Global warming** and greenhouse effect.
31	**Acid rain:** Causes and effects
32	**Ozone depletion** & depletion of ozone hole over Antarctica.
33	Urban problems related to energy
34	Water conservation, rain water harvesting, watershed management
35	Resettlement and rehabilitation of people; its problems and concerns. Case Studies
36	Wasteland reclamation
37	Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act.
38	**Human Population and the Environment:** Population growth, variation among nations, Population explosion – Family Welfare Programme.
39	Environment and human health, Women and Child Welfare, Role of Information Technology in Environment.
40	Concept of sustainability and sustainable development.
41	**Field Work:** Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc. Study of common plants, insects, birds and basic principles.
42	Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.
43	Study of simple ecosystems-pond, river, Delhi Ridge, etc.

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

O	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES											CORRELATION WI PROGRAM SPECIFI 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	PSO 4
101.1].	Apply the fundamental knowledge of environment, ecology and ecosystem to save the environment for sustainable development.	3		1			1	2					3	3			
101.2].	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				3		3	
101.3].	Develop the skill of the technique / procedures to predict / qualitatively assess the reduction in the environmental impact for sustainable development.	3	1			3	2	3		1			3	2		2	
101.4].	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				3		2	
101.5].	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	2	1	3	3

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering
Department of Mechanical Engineering
Course Hand-out
Basic Workshop Practice| ME 1130 | 2 Credits
Session: July 2018 – May 2019 | Faculty: Dr.Ashish Sharma | B.Tech First Year, Semester I/II

A. Introduction: This course is offered by Dept. of Mechanical Engineering which focuses on mainly hands on learning based on various working shops like carpentry, fitting, soldering & plumbing, lathe machine, welding and foundry. This course gives an overview of fundamental working of various machine tools, marking and cutting tools and measuring instruments.

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

[ME1130.1] Understanding about the various measuring, marking and cutting tools and Comprehend the safety measures required to be taken while using tools.

[ME1130.2] Knowledge about lathe machine and its operations.

[**ME1130.3]** Understand the process of moulding and welding processes.

[ME1130.4] Have hands on practice in carpentry and fitting work.

[ME1130.5] To fulfils the requirements of present day employers, who demand sound engineering skills employability.

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.

PROGRAM SPECIFIC OUTCOMES

[PSO.1]. Modelling & Analysis: Model and analyze mechanical engineering components using advanced software.

[PSO.2]. Alternative fuels: Analyze performance of I. C. engines attributed to alternate fuels.

[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Job preparation-	26
	File/Records-	14
	Viva-	20
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

i. Introduction: Basic workshop experiments, tools, machines and applications of processes.

ii. Machine shop (A): Study of parts of lathe machine and lathe operations.

iii. Machine shop (B): Facing, Turning, Taper Turning and knurling on MS cylindrical work piece.

iv. Foundry shop (A): Study different types of moulding processes and various tools use for foundry processes.

v. Foundry shop (B): Prepare a green sand mould and demonstration of casting with molten aluminum.

vi. Welding shop (A): Study of types of welding process and applications of welding process.

vii. Welding shop (B): Welding of different types of joint on MS plate with arc welding process.

viii. Carpentry shop (A): Cut and prepare "T halving joint part A".

ix. Carpentry shop (B): Cut and prepare "T halving joint part B".

x. Fitting shop (A): Cut and prepare mild steel square part and make all the edges at 90 degree.

xi. Fitting shop (B): Cut a 10x10 mm Notch on the mild steel Piece and make all the edges of notch at 90 degree.

xii. Soldering shop (A): Cut and Prepare part A of the funnel .

xiii. Soldering shop (B): Cut and Prepare part B of the funnel .

xiv. Plumbing shop: Cut PVC pipe 'work piece' and prepare thread on it.

F. TEXT BOOKS

T1. H.S. Bawa "Workshop Practice" McGraw Hill Education, 2009

G. REFERENCE BOOKS

R1. S K Hajra Choudhary "Elements of Workshop Technology" Media Promoters & Publishers Pvt. Ltd 2007

Lecture Plan:

Lec No	**Topics**	**Session Outcome**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing the Outcome**
1	Introduction: Basic workshop experiments, tools, machines and applications of processes.	To have clear understanding of various tools	Lecture+Lab	1130.1	Lab Experiment
2	Machine shop (A): Study of parts of lathe machine and lathe operations.	Study of Lathe machine parts	Lecture+Lab	1130.2	Lab Experiment
3	Machine shop (B): Facing, Turning, Taper Turning and knurling on MS cylindrical work piece.	Preparation of job and different operations on Lathe machines	Lecture+Lab	1130.2	Lab Experiment
4	Foundry shop (A): Study different types of moulding processes and various tools use for foundry processes.	Understanding of moulding processes	Lecture+Lab	1130.3	Lab Experiment
5	Foundry shop (B): Prepare a green sand mould and demonstration of casting with molten aluminium.	Preparation of moulding and study casting	Lecture+Lab	1130.3	Lab Experiment
6	Welding shop (A): Study of types of welding process and applications of welding process	Welding process explanation	Lecture+Lab	1130.3	Lab Experiment
7	Welding shop (B): Welding of different types of joint on MS plate with arc welding process.	Preparation and understanding of lap and butt joint in welding	Lecture+Lab	1130.3	Lab Experiment
8	Carpentry shop (A): Cut and prepare “T halving joint part A”	Knowledge on carpentry tools	Lecture+Lab	1130.4	Lab Experiment
9	Carpentry shop (B): Cut and prepare “T halving joint part B”	Preparation of different of joints in carpentry	Lecture+Lab	1130.4	Lab Experiment

10	Fitting shop (A): Cut and prepare mild steel square part and make all the edges at 90 degree.	Lecture on fitting tools	Lecture+Lab	1130.4	Lab Experiment
11	Fitting shop (B): Cut a 10x10 mm Notch on the mild steel Piece and make all the edges of notch at 90 degree.	Preparation of mild steel job	Lecture+Lab	1130.4	Lab Experiment
12	Soldering shop (A): Cut and Prepare part A of the funnel	Lecture on soldering tools	Lecture+Lab	1130.5	Lab Experiment
13	Soldering shop (B): Cut and Prepare part B of the funnel	Preparation of soldering jobs	Lecture+Lab	1130.5	Lab Experiment
14	Plumbing shop: Cut PVC pipe 'work piece' and prepare thread on it.	Preparation of job in plumbing shop	Lecture+Lab	1130.5	Lab Experiment

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
ME1130.1	Understanding about the various measuring, marking and cutting tools and Comprehend the safety measures required to be taken while using tools.			1			1		2				1
ME1130.2	Knowledge about lathe machine and its operations.				1	2				1			1
ME1130.3	Understand the process of moulding and welding processes.									1			1
ME1130.4	Have hands on practice in carpentry and fitting work.									1			1
ME1130.5	To know about plumbing and soldering procedure by preparing a job.									1			1

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

MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronics & Communication Engineering (SEEC)

Course Hand-out

Basic Electronics | EC 1101| 4 Credits | 3 1 0 4

Session: July 18 – May 19 | Faculty: Dr. Prashant Povel Dwivedi | Class: B.Tech First Year. Semester: I/II

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

[EC1101.1]. Apply principles of physics to describe and analyse the working of semiconductor devices and integrated circuits their impacts and hence develop employability skills.

[EC1101.2]. Analyse different biasing configurations of bipolar junction transistor and hence result in scope of entrepreneurship.

[EC1101.3]. Analyse inverting or non-inverting amplifier structures comprising of operational amplifiers for lifelong learning and encouraging entrepreneurship**.**

[EC1101.4]. Demonstrate inter-conversion on different number systems.

[EC1101.5]. Demonstrate minimization of Boolean expressions.

[EC1101.6]. Identify different parameters pertaining to analog modulation techniques.

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 under - standing 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.

PROGRAM SPECIFIC OUTCOMES:

[PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software

[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels

[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Open Book)	15
	Sessional Exam II (Open 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

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, LEDs.

Bipolar Junction Transistor: Construction, schematic diagram and characteristic of CE, CB Configuration, CC configuration w.r.t. CE, Relation between α and β, transistor biasing, Q-point, load line, fixed bias, self-bias, bias stabilization, Transistor as amplifiers, frequency response.

Operational Amplifier: 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, DeMorgan's Theorem, logic gates; Truth tables, SOP, POS form, K-map for minimization of Boolean expressions, Implementation of Boolean expressions with logic gates, Designing combinational circuits: Half and full adders, Half and full subtractor. Flip -flop: S-R flip-flops.
Communication Systems: Elements of communication systems, Examples of communication systems: An alog and optical communications.

F. TEXT BOOKS

T1. R. L. Boylestad, L. Nashelsky, Electronic Devices and Circuit Theory, Ninth edition, PHI.

T2. A. P. Malvino, David J Bates, Electronic Principles, Seventh edition, TMH.

T3.G. Kennedy, B. Davis, Electronic Communication systems, TMH.

G. REFERENCE BOOKS

Refer all course related books, other than text books here.

R1.J. Millman and C. C. Halkias, Integrated Electronics, Tata McGraw Hill, New Delhi. (1994).

R2.B. P. Singh and Rekha Singh, Electronic Devices and Circuits, Second Edition, Pearson Education, 2013.

G.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		EC1101.1 (CO 1)	Class Quiz, Mid Term I, End Term
2	Introduction to Extrinsic Semiconductors	Understanding of Doping	Lecture	EC1101.1 (CO 1)	Class Quiz, Mid Term I, End Term
3	Introduction to PN junction diode, Formation of depletion region	Understanding of switches	Lecture	EC1101.1 (CO 1)	Class Quiz, Mid Term I, End Term
4	Forward and reverse bias, I-V Characteristics	Understanding of switch operation and their characteristics	Lecture	EC1101.1 (CO 1)	Class Quiz, Mid Term I, End Term
5, 6	Equivalent circuits of ideal and practical diode	Model of the diode for circuits	Lecture	EC1101.1 (CO 1)	Class Quiz, Mid Term I, End Term
7	Diode equation	Introduction to the drift and diffusion in diode equation.	Lecture	EC1101.1 (CO 1)	Class Quiz, Mid Term I, End Term
8	Tutorial				
9-11	Application to Diodes: Series and Parallel combination of diode circuits	Use of switches to get different function in electrical circuits	Lecture	EC1101.1 (CO 1)	Class Quiz, Mid Term I, End Term
12	Half and Full wave rectifiers	Introduction to pulsating D.C	Lecture	EC1101.1 (CO 1)	Class Quiz, Mid Term I, End Term
13	Capacitor Filter	Introduction to Filters	Lecture	EC1101.1 (CO 1)	Class Quiz
14,15	Clipper circuits	Understanding of wave shaping circuits	Lecture	EC1101.1 (CO 1)	Class Quiz, Mid Term I, End Term
16	Clamper circuits	Understanding of wave shaping circuits	Lecture	EC1101.1 (CO 1)	Class Quiz, Mid Term I, End Term
17	Zener diode and its I-V characteristics	Understanding of voltage regulating device.	Lecture	EC1101.1 (CO 1)	Class Quiz, Mid Term II, End Term
18, 19	Zener regulators, LEDs	Understanding of voltage regulating circuits	Lecture	EC1101.1 (CO 1)	Class Quiz, Mid Term II, End Term
20	Tutorial		Quiz 1		
21	Introduction to BJT	Understanding of three terminal devices	Lecture	EC1101.2 (CO 2)	Class Quiz
22	Operation of BJT	Understanding of minority carrier movement	Lecture	EC1101.2 (CO 2)	Class Quiz

23	Transistor configuration: symbolic representation and CB Characteristics.	Characteristics of BJT under various config.	Lecture	EC1101.2 (CO 2)	Class Quiz
24	Transistor configuration: symbolic representation and CE Characteristics,	Characteristics of BJT under various config.	Lecture	EC1101.2 (CO 2)	Class Quiz
25	CC configuration w.r.t. CE, Relation between α and β	Characteristics of BJT under various config.	Lecture	EC1101.2 (CO 2)	Class Quiz, Mid Term II, End Term
26	Transistor Biasing, Q-point, Load line	Effect of load on the characteristics	Lecture	EC1101.2 (CO 2)	Class Quiz, Mid Term II, End Term
27	Fixed biasing	Effect of load on the characteristics	Lecture	EC1101.2 (CO 2)	Class Quiz, Mid Term II, End Term
28	Self-biasing, Bias stabilization	Effect of load on the characteristics	Lecture	EC1101.2 (CO 2)	Class Quiz, Mid Term II, End Term
29	Transistor as an amplifier, Frequency response	Understanding of amplifier characteristic and its response with frequency variation	Lecture	EC1101.2 (CO 2)	Class Quiz
30	Tutorial		Quiz 2		
31	Introduction to Operational Amplifier, Op. Amp Characteristics.	Understanding the OPAMP characteristics and it's difference from BJT as an amplifier.	Lecture	EC1101.3 (CO 3)	Class Quiz
32	Inverting amplifier	Application of OPAMP	Lecture	EC1101.3 (CO 3)	Class Quiz, Mid Term II, End Term
33	NON-Inverting amplifier, Linear applications of Op. Amp as voltage follower	Application of OPAMP	Lecture	EC1101.3 (CO 3)	Class Quiz, Mid Term II, End Term
34	Summing amplifier, Subtractor	Application of OPAMP	Lecture	EC1101.3 (CO 3)	Class Quiz, End Term
35	Integrator, Differentiator	Application of OPAMP	Lecture	EC1101.3 (CO 3)	Class Quiz, End Term
36	Tutorial		Quiz 3		
37	Digital Electronics: Number system	Mathematical understanding of Number System	Lecture	EC1101.4 (CO 4)	Class Quiz, End Term
38	Number conversion, Binary addition	Application of a Number System in Digital Electronics.	Lecture	EC1101.4 (CO 4)	Class Quiz, End Term
39	Binary subtraction with complements (1's and 2's complement)	Understanding of Subtraction in Digital Electronics	Lecture	EC1101.4 (CO 4)	Class Quiz, End Term

40	Boolean algebra, DeMorgan's theorem	Understanding the Algebra in Digital Electronics	Lecture	EC1101.5 (CO 5)	Class Quiz, End Term
41	Logic gates, Truth table.	Basic entities of Digital Electronics	Lecture	EC1101.5 (CO 5)	Class Quiz, End Term
42	Implementation of Boolean expression with logic gates	Use of Logic Gates to implement any Logic in Digital	Lecture	EC1101.5 (CO 5)	Class Quiz, End Term
43	SOP, POS forms	Understanding of various forms to represent a Logic	Lecture	EC1101.5 (CO 5)	Class Quiz, End Term
44	K-Map for minimization of Boolean expressions	A systematic way to minimize the given logic	Lecture	EC1101.5 (CO 5)	Class Quiz, End Term
45	Combinational Circuits: Half and Full adders	Understanding of Basic Combinational Circuits	Lecture	EC1101.5 (CO 5)	Class Quiz
46	Half and Full Subtractors	Understanding of Basic Combinational Circuits	Lecture	EC1101.5 (CO 5)	Class Quiz
47	S-R Flip Flop	Understanding of Basic Sequential Circuits	Lecture	EC1101.5 (CO 5)	Class Quiz
48	Tutorial				
49	Introduction to communication system	Basic concept of Communication	Lecture	EC1101.6 (CO 6)	Class Quiz
50	Analog and Digital communication	Understanding of different Communication Systems	Lecture	EC1101.6 (CO 6)	Class Quiz
51	Modulation techniques, Need for modulation	Understanding the importance of a Carrier and its Modulation	Lecture	EC1101.6 (CO 6)	Class Quiz
52	Types of Modulations.	Understanding the different ways to modulate a carrier	Lecture	EC1101.6 (CO 6)	Class Quiz, End Term
53	Tutorial		Quiz 4		

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
[EC1101.1]	Apply principles of physics to describe and analyse the working of semiconductor devices and integrated circuits their impacts and hence develop employability skills.	3	2	3	1			1					1	2	1	1
[EC1101.2]	Analyse different biasing configurations of bipolar junction transistor and hence result in scope of entrepreneurship.	3	2	1	2	1							**1**	2		1
[EC1101.3]	Analyse inverting or non-inverting amplifier structures comprising of operational amplifiers for lifelong learning and encouraging entrepreneurship.	3	3	3	2	**2**							1	2	1	
[EC1101.4]	Demonstrate interconversion on different number systems	3	2	3	2	**2**		1					1	2		
[EC1101.5]	Demonstrate minimization of Boolean expressions	**3**	3	1	**2**	**2**							1	2	1	1
[EC1101.6]	Identify different parameters pertaining to analog modulation techniques	**3**	2	**2**	2		1						2	2	1	

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile, Mechanical and Mechatronics

DEPARTMENT OF MECHANICAL ENGINEERING

Course Hand-out

Engineering Graphics| ME1101 | 3 Credits | 3003

Session: July 2018 – May 2019 | Course Coordinator: Dr. Mithilesh Kumar Dikshit | Class: B.Tech Sem.I/II

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:

[ME1101.1]. Students will be able to know and understand the conventions and the methods of engineering drawing.

[ME1101.2]. Students will be able to understand the theory of projections. Draw orthographic projections of lines, planes and solids.

[ME1101.3]. Apply sectional views to most practically represent engineered parts. Students will have skill to prepare basic engineering models.

[ME1101.4]. Student will have problem solving skill for various engineering design problems.

[ME1101.5] 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 under- standing 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.

Program Specific Outcomes:

[PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software
[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels
[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

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:

T1. Bhat N. D., Engineering Drawing Charotar Publishing House, Anand , 2000.

T2. Jeyapoovan T. Engineering Drawing and graphics Using AutoCAD, 3rd Ed. Vikas Publishing House Pvt. Ltd.,2010.

G. REFERENCE BOOKS:

R1. Gopalkrishna K. R., Engineering Graphics, Suhas Publications, Bangalore, 2001.

R2. Venugopal K., Engineering Drawing and Graphics + Autocad Newage International Publishers, Delhi (2001).

R3.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: ENGINEERING GRAPHICS

Lecture Number	Topics	Session Outcomes	Mode of delivery	Assessments
L1	Introduction to Engineering Graphics	Layout of drawing sheet, conventions, scales, Dimensioning, Letterings and Numberings	Board/PPT	Sheet performance in class/End terms
L2	Theory of projection. Projection of Points	Types of Projections, orthographic projections, plane of projection, Quadrants, Angles of projections	Board/PPT	
L3	Problems on projection of points	Position of point, to find distance between any two points	Board/PPT	
L4	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	Sheet performance in class/End terms
L5	Problems practice of lines inclined to one plane and parallel to other plane	Classroom practice.	Board/PPT	
L6	Projection and traces of straight line inclined to both planes	Projection of straight line inclined to both planes, determining	Board/PPT	

		apparent top view and apparent front view, angle of inclinations with both the planes.		
L7	Problems practice on Lines inclined to both planes and traces of a line	Projection of straight line and traces.	Board/PPT	
L8	Projection of planes	Introduction to plane, location of plane, types of planes, Projection concepts	Board/PPT	Sheet performance in class/End terms
L9	Problems practice on projection of planes inclined to one plane and planes inclined to both planes	Projection of planes, perpendicular planes, plane inclined to reference planes	Board/PPT	
L10	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	Sheet performance in class/End terms
L11	Problems practice on projection of solids	Projection of solids in simple positions, Position of solids in typical positions	Board/PPT	
L12	Problems on projection of solids inclined to both planes	Oblique solids, Frustum of cone and Pyramid, Truncated solids	Board/PPT	
L13	Problems on projection of solids	suspended freely and axis inclined to both planes, Axis inclined to both HP & VP, parallel to PP	Board/PPT	
L14	Problems on projection of solids	Projection of solids by auxiliary plane method; Axis inclined to both HP & VP	Board/PPT	
L15	Projection of sections of solids	Introduction, section of solids, Different terminology, classifications	Board/PPT	Sheet performance in class/End terms
L16	Projection of sections of solids	Section perpendicular to VP and parallel to HP, Section perpendicular to HP and parallel to VP	Board/PPT	
L17	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	
L18	Development of surfaces	Parallel line development, Radial line development and Triangular development	Board/PPT	Sheet performance in class/End terms
L19	Development of Surfaces	Problems on Development of Surfaces for prism, pyramid, cone cylinder	Board/PPT	
L20	Isometric view and projection	Introduction, Difference between isometric view and isometric projection, Isometric axis, isometric lines and isometric	Board/PPT	Sheet performance in class/End terms

		planes		
L21	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	
L22	Problems on Isometric projection of planes and solids	Isometric view and projection of Truncated solids, frustum	Board/PPT	
L23	Introduction to Auto CAD	Introduction, CAD applications, AUTOCAD workspace, Setting up drawing space, sheet layout, command execution	PPT	Classroom Test
L24	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	
L25	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	
L26	3D objects	Commands: EXTRUDE, CYLINDER, CONE, BOX, UNION, SUBSTRACT and SECTION	AUTOCAD	

J. COURSE ARTICULATION MATRIX: (MAPPING OF COS WITH POS AND PSOS)

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
ME1101.1	Students will be able to know and understand the conventions and the methods of engineering drawing.	3	1	2	1								2			
ME1101.2	Students will be able to understand the theory of projection. Draw orthographic projection of lines, planes and solids.	3	2	2	1								2	1		2

ME1101.3	Apply sectional views to most practically represent engineered parts. Students will have skill to prepare basic engineering models.	3	3	3	1								2			3
ME1101.4	Student will have problem solving skill for various engineering design problems.	3	3	3	2	3							2	3		3

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering
Department of Mechanical Engineering
Course Hand-out
Engineering Thermodynamics| ES 1103 | 3 Credits | 3 0 0 3
Session: July 18 – Dec 18 | Faculty: Rahul Khatri | Class: Ist Year I/IISemester

A. Introduction: Thermodynamics is a basic science that deals with equilibrium, energy and its transformation, and the laws governing such transformation. These laws are of wide applicability and are used in several branches of engineering and science. Principles and concepts of thermodynamics are important and indispensable tools in the innovation, design, development and improvement of engineering process, equipment and devices which deal with effective utilization of energy. Notable applications of engineering thermodynamics in the field of energy technology are:power producing devices, e.g., internal combustion engines and gas turbines, steam and nuclear power plant, power consuming devices, e.g., fans, blowers and compressors, refrigeration and air conditioning plants, chemical process plant and direct energy conversion devices. It is essential that every engineer should have a thorough knowledge of thermodynamics and hence thermodynamics has been an essential part of engineering curricula all over the world.

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

[ES1103.1] Understand the fundamental concepts of thermodynamics such as temperature, pressure, system, properties, process, state, cycles and equilibrium in the context of engineering applications.

[ES1103.2] Apply first law of thermodynamics on flow and non-flow processes.

[ES1103.3] Design and analyse the concept of components (compressor, turbine, pump, etc.) with the use of thermodynamic law to enhanced the skills for industrial applications.

[ES1103.4] Analyse the concept of second law and entropy in the context of thermal applications.

[ES1103.5] Apply the concept of first & second law of thermodynamics to design/utilize the power generating and power consuming devices.

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 under- standing 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.

PROGRAM SPECIFIC OUTCOMES:

PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software
[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels
[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

D. Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Open Book)	15
	Sessional Exam II (Open Book)	15
	Quizzes (Open Book/Close Book) and Assignments	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.	
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

Definitions & Concepts: SI Units; System, Thermodynamic Properties of Fluids: Mathematical, Tabular and Graphical representation of data; Ideal gas Van der Waals Equation of state; Compressibility chart; Thermodynamic Diagrams including Mollier diagram; Steam Tables. Zeroth Law of thermodynamics: temperature scale. First Law of Thermodynamics: Applications to Non flow processes, Applications of First Law of Thermodynamics of Flow Processes – Steady State / Transient; Applications of First Law of Thermodynamics to Chemically Reacting Systems. Second Law of Thermodynamics: Applications. Thermodynamic Relations: Thermodynamic Potentials, Maxwell's Relations; Availability. Power Cycles and Refrigeration Cycles, Gas-Vapor Mixtures and Psychrometry.

F. Text Book:

T1. An Introduction to Thermodynamics, YVC Rao, Universities Press (India) Private Limited, Revised Edition, 2004.

G. Reference Book:

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

H. Lecture Plan:

Lec No	Topics	Session Objective	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction to Thermodynamics	Know the basics of the course and understand its applications	Lecture	ES1103.1	Home Assignment and Class Quiz Mid-Term I End-Term
2	Concepts and Definitions- System, Surroundings, Intensive and Extensive Properties, Energy, Equilibrium	Discuss the terms system and surroundings, thermodynamic properties and describe their use	Lecture	ES1103.1	
3	Equilibrium, Stability, Process, Work	Understand the criteria of thermal equilibrium, mechanical equilibrium and chemical equilibrium	Lecture	ES1103.1	
4	Work, Definition of Thermodynamics, Modes of work, Heat	Brief about the thermodynamics definition of work, distinguish between heat and work and identify their effects	Lecture	ES1103.1	Home Assignment and Class Quiz Mid-Term I End-Term
5	Thermodynamic Properties of Fluids- Concepts of phases, Equations of state	Understand a pure substance and a phase and phase transformation	Lecture	ES1103.1	
6	Ideal gas, van der Waals equation, Critical constants	Understand the concept of ideal gas and van der Walls equation of state	Lecture	ES1103.1	
7	Other equations of state, Compressibility chart, Reduced equation of state, Generalized compressibility chart	Use of compressibility chart and generalized compressibility chart and its applications	Lecture	ES1103.1	Home Assignment and Class Quiz Mid-Term I End-Term
8	Graphical representation of data – T-V diagram, P-V diagram, P-T diagram, Mollier diagram	Understand various thermodynamic diagrams like T-v, P-v, P-T, and Mollier diagram	Lecture/Activity	ES1103.1	
9	Tabular representation of data, Steam table	Estimating the properties of steam using steam tables.	Lecture/Activity	ES1103.1	
10	Zeroth law of thermodynamics, First law of thermodynamics- History	Understand the Zeroth law of thermodynamics	Lecture	ES1103.1 ES1103.2	Home Assignment and Class Quiz Mid-Term I End-Term
11	First law of thermodynamics, Consequences, Analysis of elementary processes	Know the genesis of the first law of thermodynamics	Lecture	ES1103.2	
12	Analysis of elementary processes, Isothermal processes, Adiabatic processes, Polytropic processes	Apply the first law of thermodynamics to analyse different thermodynamics process	Lecture	ES1103.1 ES1103.2	
13	Constant internal energy processes	Apply the first law of thermodynamics to analyse constant internal energy process	Lecture	ES1103.1 ES1103.2	Home Assignment and Class Quiz Mid-Term I End-Term

14	First law analysis of processes – Control mass analysis, Control volume analysis	Explain the control mass and control volume analysis	Lecture	ES1103.2 ES1103.3	
15	Applications of steady state flow processes, Throttling process, Applications of throttling	Analyse the steady flow processes and its applications	Lecture	ES1103.2 ES1103.3	
16	Transient flow processes, Case of an ideal gas	Analyse the transient flow processes.	Lecture	ES1103.1 ES1103.2 ES1103.3	Home Assignment and Class Quiz Mid-Term II End-Term
17 & 18	Second law of thermodynamics- Heat engine, Heat pump or refrigerator, Second law of thermodynamics	Understand the concept of second law and its requirement	Lecture/Lab Visit	ES1103.4	
19	Kelvin, Plank, and Clausius statement, Reversible and Irreversible reactions, Criteria for irreversible processes	Understand the statements of second law of thermodynamics and also discuss the criteria for irreversible process	Lecture	ES1103.4	
20	Carnot cycle, Carnot theorem, Thermodynamic temperature scale	Understand the Carnot cycle and its use in thermodynamics	Lecture	ES1103.4	Home Assignment and Class Quiz Mid-Term II End-Term
21	Clausius inequality, Entropy, Calculation of entropy change	State the Clausius inequality and calculate the entropy change of the system	Lecture	ES1103.4	
22	Principles of entropy increase, Temperature-entropy diagram	Understand the principles of entropy increase and its reason	Lecture	ES1103.4	
23	Available energy, Loss in available energy,	Define the available and unavailable energy through the concept of second law	Lecture	ES1103.4	Home Assignment and Class Quiz Mid-Term II End-Term
24	Availability and Irreversibility	Estimate the loss in available energy in a given process	Lecture	ES1103.4	
25	Thermodynamic relations- Maxwell's relations, Mnemonic diagram, Thermodynamic	Understand the importance the Maxwell's relations	Lecture	ES1103.3 ES1103.4	
26	Thermodynamic potentials, Mathematical preliminaries, Entropy	Know the thermodynamic potentials	Self-Study	ES1103.3 ES1103.4	Home Assignment and Class Quiz Mid-Term II End-Term
27	Joule-Thompson coefficient, Clapyeron equation, Gibb's phase rule	Understand the Joule-Thompson coefficient, Clapyeron equation, Gibb's phase rule	Lecture	ES1103.3 ES1103.4	
28	Power and Refrigeration cycles-Classification, Vapor power cycles, Carnot vapor power cyc	Classify the power cycles into vapour cycles and gas power cycles	Lecture	ES1103.1 ES1103.3 ES1103.5	Home Assignment and Class Quiz End-Term
29	Ideal Rankine cycle and practical Rankine cycle	Explain the basics of Rankine cycle and estimate the thermal efficiency of an Ideal and actual Rankine cycle	Lecture	ES1103.1 ES1103.3 ES1103.5	
30 & 31	Gas power cycles, Otto cycle, Diesel cycle	Analyse the Otto and diesel cycle	Lecture/Lab Visit	ES1103.1 ES1103.3	

				ES1103.5	
32	Comparison of Otto and Diesel cycle, Air standard dual cycle	Analyse the differences in Otto, Diesel and dual cycle	Lecture	ES1103.1 ES1103.3 ES1103.5	Home Assignment and Class Quiz End-Term
33	Ideal and Actual Brayton	Analyse air standard Brayton cycle	Lecture	ES1103.1 ES1103.3 ES1103.5	
34 & 35	Refrigeration cycle, Vapor compression refrigeration cycle	Understand the practical refrigeration cycle and its components	Lecture/Lab Visit	ES1103.1 ES1103.3 ES1103.5	
36	Refrigerants, Gas refrigeration cycle	Know the criteria in selection of refrigerants and their use	Self-study	ES1103.1 ES1103.3 ES1103.5	Home Assignment and Class Quiz End-Term
37	Gas vapor mixtures and Psychrometry, ideal gas mixtures	Predict the properties of an ideal gas mixture from knowledge of the properties of the constituent species	Lecture	ES1103.1 ES1103.2 ES1103.5	
38	Psychrometer, Psychrometric chart	Use the psychrometric charts in the analysis of process of dealing with air-water vapour mixtures	Activity	ES1103.1 ES1103.5	

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
ES1103.1	Understand the fundamental concepts of thermodynamics such as temperature, pressure, system, properties, process, state, cycles and equilibrium in the context of engineering applications.	3													1	
ES1103.2	Apply first law of thermodynamics on flow and non-flow processes.	3	2													
ES1103.3	**Design and analyse the concept of components (compressor, turbine, pump, etc.) with the use of thermodynamic law to enhanced the skills for industrial applications.**	3		3	2										1	
ES1103.4	Analyse the concept of second law and entropy in the context of thermal applications	3	2	3	2		2	2							1	
ES1103.5	Apply the concept of first & second law of thermodynamics to design/utilize the power generating and power co	3	3	3			2	2							1	

MANIPAL UNIVERSITY JAIPUR

School of Civil and Chemical Engineering

Department of Civil Engineering

Mechanics of Solids | ES1102| 4 Credits | 3 1 0 4 1

Session: July 18 – May 19 | Faculty: Prof. Keshaw Jee Sharma | Class: B.Tech. First Year. Semester: I/II

A. Introduction:

This course is offered by Dept. of Civil Engineering as a Core Course for first year students. Mechanics of solids includes important topics from Engineering Mechanics and Strength of Materials. The subject offers a basic understanding of different types of forces acting on rigid bodies at rest and in stage of motion. Most of the fundamentals needed to learn the basics of Engineering Mechanics and strength of materials are discussed in this subject. Strength of materials is a basic course essential for students of all branches of engineering. Modern research and advancement in field of stability, strength and design of structure and machines, dynamic effects. robotics, missiles. Aeroplane and aircraft design, automobiles and automatic control. fluid flow, engine performance, electrical machines, transmission tower, superstructure, heavy earthmoving machines, locomotives, metro railway, supersonic aircrafts, atomic and subatomic behaviour etc. are highly dependent on basic principle of Mechanics of Solids In this coursework, students will be trained about methods of analysing forces, determination of centroid and moment of inertia of geometrical figures, determination of various stresses and strains, longitudinal and circumferential stresses and strains due to direct forces , thermal stresses; strains in metallic materials and stresses due to fluid pressures.. Also they will develop skill for testing various building and machinery materials such as- mild steel, cast iron etc. as per Indian standards guidelines. The course will include activities such as- assignments, quizzes, class tests, site visits, projects, focusing on the knowledge of students for lifelong learning and making them employable.

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

[ES1102.1] Develop the skill to evaluate forces in various engineering elements
[ES1102.2] To locate the centroid and determine the Moment of inertia of various bodies
[ES1102.3] Analysis of dynamics forces to be used in machinery and building component
[ES1102.4] To assess the engineering properties of material subjected to normal, shear and temperature stresses.
[ES1102.5] To examine the stress and strain in thin cylinders and pipes along the longitudinal and circumferential direction.

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.

PROGRAM SPECIFIC OUTCOMES:

PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software

[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels

[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	15
	Sessional Exam II (Close Book)	15
	Quiz Test (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 Quiz Test (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup Quiz 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 6 to 8 throughout the entire semester.	
Homework/ Home Assignment/	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	

Activity Assignment (Formative)	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

Mechanics of Rigid Bodies: Introduction, basic principles and concepts, Force systems, resultant of concurrent and non-concurrent coplanar force systems; Equilibrium of concurrent and non -concurrent coplanar force systems. Centroid and Moment of Inertia of simple and composite areas, Kinetics: Applications of D'Alembert's principle, work -energy and ImpulseMomentum principles. Mechanics of Deformable Bodies: Mechanical properties of materials, normal stress and strain, Hooke's law, modulus of elasticity, tension test on ductile and brittle materials, factor of safety, allowable stress, Poisson's ratio, shear stress and shear strain, modulus of rigidity, relation between modulus of elasticity, modulus of rigidity and bulk modulus. Stresses and deformations in tapering bars, stepped bars, thermal stresses, statically indeterminate problems, Stresses on inclined planes, stresses in thin cylindrical pressure-vessels

F. TEXT BOOKS

T1. S.S. Bhavikatti & Rajsekharappa, Engineering Mechanics, New Age International, 2012

T2. S.S. Bhavikatti, Strength of Materials, Vikash Publishers, Jan 2016

G. REFERENCE BOOKS

R1. Beer and Johnson; Engineering Mechanics R.K.Bansal; Engineering Mechanics, 3rd edition

R2. Timoshenko; Strength of Materials

R3. R.K.Rajput; Strength of Materials , 6th edition2o15 , S. Chand Publishing

I. Lecture Plan:

Lecture No.	Topics to be covered
	PART-I MECHANICS OF RIGID BODIES
1	**Resultant of concurrent and non-concurrent forces:-** Definition of mechanics, force, principle of transmissibility
2	Classification of force system, resultant of concurrent coplanar forced, parallelogram and triangle law of forces, component of a force, resolution of a force, rectangular component of force and oblique components of a force
3	Illustrative Problems
4	Illustrative Problems
5	Illustrative Problems
6	Resultant of coplanar non –concurrent force system, moment of a force, couple, force and couple system, Varignon's theorem, types of loads on beams
7	Illustrative Problems
8	Illustrative Problems
9	**Equilibrium of concurrent and non con-current coplanar force system:** Definition, condition of equilibrium, Lami's theorem , space diagram and Free Body Diagram, types of supports, types of beams and types of loading
10	Problems on equilibrium of coplanar concurrent force system
11	Problems on equilibrium of coplanar concurrent force system
12	Problems on equilibrium of coplanar concurrent force system
13	Problems on resultant of coplanar non-concurrent force system
14	Problems on resultant of coplanar non-concurrent force system
15	Problems on resultant of coplanar non-concurrent force system
16	Tutorials based on L1-L15
17	**Centroid of plane area :-** Definition, derivation of Centroid of rectangle, circle,
18	Semi-circle, quarter circle, triangle, determination of centroid of composite area
19	Problems on determination of centroid of composite area
20	Problems on determination of centroid of composite area
21	Problems on determination of centroid of composite area
22	**Moment of Inertia:-- Definition,** Theorem of parallel and perpendicular axes, Radius of gyration, M. I. of standard plane lamina like rectangle, triangle and quarter circle
23-24	Problems on determination of M.I. for composite areas
25	**Kinetics of rectilinear motion:-** Newton's second law of motion, work energy principle and impulse momentum principle, D' Alembert's principle
26	Problems on kinetics using above methods

27	Problems on kinetics using above methods
	Part –II MECHANICS OF DEFORMABLE BODIES
28	**Simple Stresses and Strains:-** Introduction to mechanics of deformable, normal stress and strains, Hooke's law, modulus of elasticity
29	Tension test on ductile and brittle materials, factor of safety, allowable stress Tapering Problem ------Illustrative problems
30	Tapering bars, Illustrative problems
31	Stepped bars Illustrative problems
32	Shear stress, shear strain single and double shear, modulus of rigidity
33	Poisson's ratio, bulk modulus, relationship between volumetric strain and linear strain
34	Relationship between modulus of elasticity, modulus of rigidity and bulk modulus
35	Illustrative Problems
36	**Statically indeterminate members and thermal stresses:-** Compound bars subjected to external loads
37	Illustrative problems
38	Illustrative problems
39	Illustrative problems
40	Temperature stresses, compound bar subjected to temperature stresses, illustrative problems
41	Illustrative Problems
42	Illustrative Problems
43	**Stresses on inclined plane:-** equation of stresses on inclined planes, condition for maximum and normal stresses on a plane, concept of principal plane and principal stresses, condition for maximum shear stress on plane and plane of maximum shear stress, resultant stress on a plane
44	Illustrative examples
45	Illustrative problems
46	**Stresses in thin cylinder** due to fluid pressure :-Analysis of thin cylinders subjected to fluid pressure- hoop stress, longitudinal stress and strain, joint efficiencies
47	Illustrative problems
48	Illustrative problems and doubt clarification.

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	PSO 4	
[ES1102.1]	Develop the skill to evaluate forces in various engineering elements	3	2	2	1	1	1	2	1			1	1	2	2	2		
[ES1102.2]	To locate the centroid and determine the Moment of inertia of various bodies	3	3	2	3	3	2	1	1			1	1	2	2	2		
[ES1102.3]	Analysis of dynamics forces to be used in machinery and building component	3	2	3	3	3	1		1	2	3	1	1	2		1	3	
[ES1102.4]	To assess the engineering properties of material subjected to normal, shear and temperature stresses	3	2	2	2	2	2			2	2		1		1	1	2	
[ES1102.5]	To examine the stress and strain in thin cylinders and pipes along the longitudinal and circumferential direction.	3	2	2	2	2	2		1	2	2	1	1		1	1	1	

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

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Chemistry Course Hand-out

Engineering Chemistry | CY1101| 4 Credits | 2114

Session: July 18 – May 19 | Faculty: Arunava Agarwala | Class: B. Tech First Year Semester: I/II

A. Introduction: This course is offered by Dept. of Chemistryfor 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 student with the knowledge of the basic chemistry, will understand and explain scientifically the various chemistry related problems in the industry/engineering field.

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

[CY 1101.1].	Understand and apply concepts of various types of fuel technology.
[CY 1101.2].	Develop new methods to produce soft water for industrial use.
[CY 1101.3].	Understand the synthesis and applications of polymer science and polymer technology.
[CY 1101.4].	Develop skills to synthesis, analysis and use of composite method.
[CY 1101.5].	Understand and apply the concepts in electro chemistry and corrosion science in protecting metallic objects.
[CY 1101.6].	Acquire basic knowledge of nanochemistry to appreciate is application in the field like medicine, opto-electronics and electronics.

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 under - standing 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.

[PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software
[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels
[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Open Book)	15
	Sessional Exam II (Open Book)	15
	Quiz tests (Accumulated and Averaged)	10
	Practical	20
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.	
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 will help the	

E. SYLLABUS

Chemical Fuels: Classification; Calorific value and its determination; Analysis of solid fuel; Liquid Fuel: Distillation of petroleum, Petroleum cracking, Reforming of petrol, Octane number and Cetane value, Synthetic petrol, Combustion based numerical; **Water Technology**: Hardnessof water; Units of hardness; Ion exchange water softening technique; Boiler feed water: scale &sludge, priming and foaming; **Polymers & Composites**: Molecular weight determination; Glasstransition temperature; Methods of polymerization; Mechanism of polymerization reactions; Compounding of plastics; Vulcanization; Conducting polymers; Synthesis, properties and applications of some polymers; Composition and characteristic properties of composites; **Nano Chemistry:** Synthesis, properties and applications of selected nanomaterials; **Corrosion and its Control**: Theories and Mechanism of Corrosion; Types of corrosion; Factors affecting corrosion, Protection against corrosion, Paints and Coatings: Antifouling Coating, Fire retardant paint sand Case studies.

F. TEXT BOOKS

T.1. Jain P.C. and Jain M., Engineering Chemistry, DhanpatRai and Sons, Delhi, Revised, 15th Edn. 2006.

T.2. 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:

Lecture No.	*Topics*
1.	**Chemical fuels:** Introduction, Classification, Units of heat, Calorific value: Gross calorific value and Net calorific value.
2.	Description of working of Bomb calorimeter for detection of caloric value of solid /non -volatile liquid fuel; Discussion about all corrections.
3.	Numerical problems based on Bomb calorimeter.
4.	Description of working of Boy's calorimeter for detection of caloric value of gaseous fuel; Numerical problems based on Boy's calorimeter.
5.	Dulong's Formula; Numerical problems based on Dulong's Formula; Coal analysis: Proximate analysis.
6.	Coal analysis: Ultimate analysis; Numerical problems related to Proximate and Ultimate analysis.
7.	Liquid Fuels: Fractional Distillation, Petroleum Cracking - Fixed Bed catalytic cracking.
8.	Moving bed Catalytic Cracking; Knocking, Octane number, Anti-knocking agents, Unleaded petrol and power alcohol, Cetane number.
9.	Reforming of Gasoline: Thermal and Catalytic reforming, Synthetic Petrol, Bergius process, Fisher Tropsch method.
10.	Numerical based on Combustion (By Weight Type).
11.	Numerical based on Combustion (By Volume Type).
12.	**Water Technology:** Introduction, Hardness of water, Important units of hardness.
13.	Numerical problems based on hardness.
14.	Estimation of hardness: Soap solution method and EDTA method.
15.	Softening of water: cold and hot Lime soda process and numerical problems (calculation of amount of lime and soda).
16.	Softening of hard water by Ion exchange method and zeolite method.
17.	Internal treatment: Phosphate conditioning and Calgon conditioning.
18.	Boiler problems: scale and sludge formation,priming and foaming and preventive methods.
19.	**Polymers and Composites:** Definition and classification of polymers: based on structure, origin, tacticity, and heating behavior (thermo plastic/ thermosetting).
20.	Functionality; Degree of polymerization; Co-polymerization: alternating, random, block and graft polymers.
21.	Molecular weight of polymers: Number average and weight average molecular weights, polydispersity index; Numerical problems based on average molecular weight.
22.	Mechanism of free radical polymerization and ionic (both cationic and anionic) polymerization.
23.	Mechanism of coordination polymerization (Zieglar Natta Catalyst), Condensation polymerization: definition and examples.
24.	Polymerization techniques: Bulk, Solution, Suspension and Emulsion.
25.	Glass transition temperature & factors affecting it.
26.	Elastomer: Natural rubber, Vulcanization, Synthetic rubbers.

27.	Preparation, properties and applications of Polythene (LDPE and HDPE) and Nylon: 6, 6:6, 6:10, 11.
28.	Preparation, properties and applications of Phenol Formaldehyde resins (Novolacs / Resols).
29.	Composites and its Classification.
30.	Characteristic Properties of Composites.
31.	Corrosion and its Control:Introduction, Significance, Chemical Corrosion, Pilling Bedworth Rule (Pilling–Bedworth ratio (P–B ratio).
32.	Electrochemical Corrosion.
33.	Types of corrosion: Galvanic corrosion, Pitting corrosion.
34.	Water line Corrosion; Drop Corrosion; Stress corrosion (caustic embrittlement).
35.	Factors affecting corrosion: the nature of the metal and environment.
36.	Corrosion prevention by material selection and design; Protection against corrosion: Sacrificial anodic protection, Impressed current method, anodic protection; Corrosion inhibitors (cathodic/anodic).
37.	Electroplating, galvanization, tinning and other metal coating methods.
38.	Paints and Coatings: Antifouling Coating, Fire Retardants Paints.
39.	**Nano-Chemistry**: Introduction, Synthesis of Nano Materials: Top down and Bottom up approach.
40.	Synthesis, properties and applications of Fullerenes and Carbon Nano tube.
41	General Properties of Nano Materials.
42.	Revision.

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
CY 1101.1	Apply concepts of fuel technology in Industrial application	2						2			2		2			
CY 1101.2	Develop new methods to produce soft water for industrial application			2					1				3			
CY 1101.3	Apply concepts of synthesis and applications of polymer science and polymer technology	2				1					1		2			
CY 1101.4	Recognize the synthesis, analysis and use of composite materials								1				2			
CY 1101.5	Employ the concepts in electrochemistry and corrosion science in protecting metallic objects		2			2			1				3			
CY 1101.6	Acquire basic knowledge of Nanochemistry and its various applications.	2				3			1				3			

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

MANIPAL UNIVERSITY JAIPUR

Faculty of Engineering

B.Tech. First Year (All branches)

DEPARTMENT OF MATHEMATICS AND STATISTICS

Course Hand-out

Engineering Mathematics-II| MA1201 | 4 Credits | 3 1 0 4

Session: Jan– May 2019 | Faculty: Dr. GirrajMethi & Dr. M. Rizwan | Class: B.Tech 1st Semester I/II

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 subjects.

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

[MA1201.1]. Demonstrate the understanding of First order and First Degree differential Equation.

[MA1201.2]. Apply and solve higher order linear differential equations and simultaneous differential equation.

[MA1201.3]. Develop the skill to use Beta Gamma function in mathematics problem.

[MA1201.4]. Able to change order of double integration and double integral in Cartesian form to polar form and vice versa.

[MA1201.5]. Solve triple integral Final area and volume of solids using double integral
[MA1201.6]. Understand and can handle solid coordinate figure sphere, Right circular cone and Right circular cylinder.

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 under - standing 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.

PROGRAM SPECIFIC OUTCOMES:

[PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software
[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels
[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Open Book)	15
	Sessional Exam II (Open 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

Ordinary Differential Equations: Solutions of first order and first degree differential equations, separable of variables, homogeneous and reducible to homogeneous equations, linear equations & Bernoulli equation, ex act equations, reducible to exact. **Linear Higher Order Differential Equations**: Linear homogeneous equations with constant coefficients, inverse differential operators and method of variation of parameters, Solution of Cauchy's and Legendre's differential equations, solution of simple simultaneous linear differential equations. **Multiple Integrals**: Beta and Gamma Functions: elementary properties. Double and Triple integrals, area and volume by double integration, change of order of integration, change of variables from Cartesian to polar form and vice versa. **Analytical Solid Geometry**: Sphere, Right Circular Cones, Right Circular Cylinder.

F. TEXT BOOKS

T1. B. S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers, Delhi, 2006.
T2. E. Kreyzig, *Advanced Engineering Mathematics*, Wiley Eastern, 2006.

G. REFERENCE BOOKS

R1. E.D.Rainville & P.E.Bedient, *A Short Course in Differential Equations*, Macmillan Pub.
R2. Shanti Narayan, *Differential Calculus*, Shyam Lal Charitable Trust, Delhi, 2002.
R3. C. B. Thomas, *Calculus and Analytical Geometry*, Narosa Pub., Delhi, 1996.
R4. N. Piskunov, *Differential Calculus & Integral Calculus*, Vol. I and II, Mir Pub., 1981.
R5. G. Hadley, *Linear Algebra*, Narosa Publishers, 200

H. LECTURE PLAN:

Lecture No.	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1.	Introduction of Ordinary differential equations-Definition, order & degree of a differential equation	Lecture	[1201.1]	Mid Term - I End Term
2.	Solution of first order and first degree differential equations using Variable separable method	Lecture	[1201.1]	Mid Term - I End Term
3.	Solution of Homogeneous differential equations	Lecture	[1201.1]	Mid Term - I End Term
4.	Equations reducible to homogeneous form	Lecture	[1201.1]	Mid Term - I End Term
5.	Problems of equations reducible to homogeneous form	Lecture	[1201.1]	Mid Term - I End Term
6.	Problem Solving	Tutorial	[1201.1]	Mid Term - I End Term
7.	Solution of Linear differential equations	Lecture	[1201.1]	Mid Term - I End Term
8.	Solution of Bernoulli's equation	Lecture	[1201.1]	Mid Term - I End Term
9.	Solution of Exact differential equations	Lecture	[1201.1]	Mid Term - I End Term
10.	Equations reducible to exact differential equations	Lecture	[1201.1]	Mid Term - I End Term
11.	Problems and different IF for reducible Exact differential equations	Lecture	[1201.1]	Mid Term - I End Term
12.	Problem Solving	Tutorial	[1201.]	Mid Term - I End Term
13.	Applications of first order and first degree differential equations in	Lecture	[1201.1]	Mid Term - I End Term

	real world problems			
14.	Introduction and develop theory for CF	Lecture	[1201.2]	Mid Term - I End Term
15.	ways for finding CF	Lecture	[1201.2]	Mid Term - I End Term
16.	Linear homogenous higher order differential equations with constant coefficients	Lecture	[1201.2]	Mid Term - I End Term
17.	Problem Solving	Tutorial	[1201.2]	Mid Term - I End Term
18.	Inverse differential operator	Lecture	[1201.2]	Mid Term - I End Term
19.	Rules for finding Particular integral for exponential and trigonometrical cases	Lecture	[1201.2]	Mid Term - I End Term
20.	Rules for finding Particular integral for remaining cases	Lecture	[1201.2]	Mid Term - I End Term
21.	Develop Method of variation of parameters	Lecture	[1201.2]	Mid Term – II End Term
22.	Problems related to method of varation of parameter	Lecture	[1201.2]	Mid Term – II End Term
23.	Solution of Cauchy's equation	Lecture	[1201.2]	Mid Term – II End Term
24.	Problem Solving	Tutorial	[1201.2]	Mid Term – II End Term
25.	Solution of Legendre's equation	Lecture	[1201.2]	Mid Term – II End Term
26.	Solution of simple simultaneous linear differential equations	Lecture	[1201.2]	Mid Term – II End Term
27.	Problem Solving	Tutorial	[1201.2]	Mid Term – II End Term
28.	Applications of Linear higher order differential equations in real world problems	Lecture	[1201.2]	Mid Term – II End Term
29.	Beta & Gamma functions: Concept and Definitions	Lecture	[1201.3]	Mid Term – II End Term
30.	Properties and problems of beta function	Lecture	[1201.3]	Mid Term – II End Term
31.	Properties and problems of Gamma function	Lecture	[1201.3]	Mid Term – II End Term

32.	Problem Solving	Tutorial	[1201.3]	Mid Term – II End Term
33.	Double Integral & Tripal Integral	Lecture	[1201.4]	Mid Term – II End Term
34.	Area by double integration	Lecture	[1201.4]	Mid Term – II End Term
35.	Volume by double integration	Lecture	[1201.4]	Mid Term – II End Term
36.	Problem Solving	Tutorial	[1201.4]	Mid Term – II End Term
37.	Change of order of integration	Lecture	[1201.4]	Mid Term – II End Term
38.	Change of variables from Cartesian to polar form	Lecture	[1201.5]	Mid Term – II End Term
39.	Change of variables from Polar to Cartesianform	Lecture	[1201.5]	Mid Term – II End Term
40.	Problem Solving	Tutorial	[1201.5]	Mid Term – II End Term
41.	Three D: Basic Concepts	Lecture	[1201.6]	End Term
42.	Introduction to Sphere Equation of sphere with problems	Lecture	[1201.6]	End Term
43.	plane section of sphere	Lecture	[1201.6]	End Term
44.	Problem Solving	Tutorial	[1201.6]	End Term
45.	Right circular cone	Lecture	[1201.6]	End Term
46.	Right circular cylinder	Lecture	[1201.6]	End Term
47.	Problems based on right circular cone & cylinder	Lecture	[1201.6]	End Term
48.	Problem solving	Lecture	[1201.6]	End Term

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

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
1201.1	Demonstrate the understanding of First order and First Degree differential Equations	3	2	3	1	1		1					1				
2101.2	Apply and solve higher order linear differential equations and simultaneous differential equations	3	2	1	2	1											
1201.3	Develop the skill to use Beta Gamma function in mathematical problems	3	3	2	2						1						
1201.4	Able to change order of double integration and double integral in Cartesian form to polar form and vice versa	2	1	2	1	1		1									
1201.5	Solve triple integral find area and volume of solids using double integral	2	3	1	1	1							1				
1201.6	Understand and can handle solid coordinate figure Sphere, Right circular cone and Right Circular Cylinder					1											

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

MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronics and Communication

Department of Electrical Engineering

Course Hand-out

Electrical Engineering | EE 1101 | 4 Credits | 4 0 0

Session: Jul 18 – Dec 18 | Faculty: Dr. Ashish Shrivastava | Class: First Year Semester I/II

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: -

a) To develop general insight of circuit laws and theorems.
b) To analyse the magnetic & electric circuit and calculate different parameters
c) To develop and analyse the single and three phase circuits.
d) To understand the concepts of basic construction & operation of transformers, DC & Induction motors.
e) To understand the fundamentals of measuring Instruments.

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

[EE1101.1]. Recall basic circuit laws and apply theorems to analyse different types of DC circuits.
[EE1101.2]. Analyze and illustrate the comparison between linear electric & magnetic circuits.
[EE1101.3]. Identify and evaluate different configurations of single phase & three phase ac circuits.
[EE1101.4]. Understand the construction and operating principle of transformers.
[EE1101.5]. 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 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 engineerin g 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 under - standing 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.

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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.

PROGRAM SPECIFIC OUTCOMES:

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[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels

[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

D. Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Open Book)	15
	Sessional Exam II (Open Book)	15
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	30
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	Total	100
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E. Syllabus

Introduction to Indian power scenario, Domestic appliances, Basic circuit elements, Source Transformation, Series

& parallel resistive circuits, Review of Kirchhoff's laws, Star Delta Transformations, **DC Circuit Analysis:** Mesh and Node voltage analysis, DC Network Theorems-Superposition, Thevenin, Norton, Maximum Power Transfer. Capacitor and Inductor Series & Parallel connections, Charging & Discharging, Energy stored. **Magnetic circuits:** Terminologies, Analysis of series and parallel magnetic circuits, Review of Electromagnetism, Electromagnetic Induction, Fleming's left & right hand rules, Faradays laws, Lenz's law, Induced emf in a conductor & coil, Mutual Inductance, Coupling Coefficient and dot rule. **Single phase AC circuits:** Generation, EMF induced, Average value, RMS value, Peak factor, Form factor, Phasors, Analysis of Pure R, L, C Series and parallel combinations (RL, RC and RLC circuits), Power, Power factor, series and parallel Resonance. **Three phase AC Circuits:** Star and Delta connections, Analysis with balanced loads, Power measurements. **Transformers:** Single phase transformer- types, Construction, working principle, ideal and practical transformers, losses, Efficiency, Regulation. **Electrical Motors:** Introduction of Single & Three phase Induction motors, DC Motors. **Electrical Instruments:** Fundamentals of Electrical Measuring Instruments.

F. TEXT BOOKS

T1. Nagasarkar & Sukhija, Basic Electrical Engineering, Oxford University Press, 2006.

T2. S.K. Sahdev, Fundamentals of Electrical Engineering & Electronics, Dhanpat Rai & Co, 2010.

T3. D. C. Kulsheshtha, Basic Electrical Engineering, McGraw Hill Education India, 2011.

G. REFERENCE BOOKS

R1. S. N. Singh, Basic Electrical Engineering, PHI, 2011.

R2. D. P. Kothari. & I. J. Nagarath, Basic Electrical Technology, TMH 2004.

H. Lecture Plan:

Lec No	**Topics**	**Session Objective**	**Mode of Delivery**	**Corresponding CO**	**Mode of the Assessing 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 factor	Describe the phasor operations and calculation of different quantities pertaining to different combinations of series ac circuits	Lecture	[1101.3]	Mid Term Exam
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 accircuits	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	[1101.4]	Class Quiz
L39-L40	DC Machine: Introduction, Construction, Types	Describe the construction and operating principle of DC machine	Lecture	[1101.4]	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												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
EE 1101.1	Recall basic circuit laws and apply theorems to analyse different types of DC circuits.	3	2										2	3		
EE 1101.2	Analyze and illustrate the comparison between linear electric & magnetic circuits.	2	1										2	1		
EE 1101.3	Identify and evaluate different configurations of single phase & three phase ac circuits.	1	2										3	3	1	
EE 1101.4	Understand the construction and operating principle of transformer.	2	2	1			1	1					2	1	2	
EE 1101.5	Illustrate the basic operating principles of DC machines & Induction motors and fundamental measuring Instruments						1	1						1		

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

MANIPAL UNIVERSITY JAIPUR

School of Computing and Information Technology

Department of Computer Science & Engineering

Course Hand-out

Programming in C| CS 1101 | 4 Credits | 2 1 1 1 4

Session: July 2018 – May 2019 | Faculty: Dr. Manoj Kr. Sharma | Class: B.Tech 1st Year Semester I/II

A. Introduction

The main objective of this course is for students to be aware with basic computer fundamentals, number systems and to enhance problem solving and logic design skills through writing set of instructions to solve a real world problem through C programming. Students will spend a significant time on each topic to understand their essential requirements and to use them differently with distinct programmable problems.

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

[CS1101.1]: Described a deep knowledge of computer for better understanding of devices, basic fundamental of computer comprises in this course.

[CS1101.2]: Design flow chart, Write algorithm and pseudo code parallel with Control Statements to understand flow of program execution.

[CS1101.3]: Understand bitwise operations and conversion of numbers in different representations through Number System.

[CS1101.4]: Developing skills in students to learn memory oriented operation using pointers and understating programming skills by Array, Structure, Union, Enum and String are added.

[CS1101.5]: Students learned the concept of re-usability by means of functions in C and to illustrate the concept of data base using file handling.

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 under - standing 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.

PROGRAM SPECIFIC OUTCOMES:

[PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software

[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels

[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

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/or Assignments , Activity feedbacks (Accumulated and Averaged)	10
End Term Exam (Summative)	End Term Exam (Open Handwritten Notes)	40
Lab	Practical Lab	20
	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, "Computer Fundamentals & C Programming", TMH, 2008.

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

G.REFERENCE BOOKS

R1.B. W. Kernighan, D. M. Ritchie, "The C Programing Language", 2nd Edition, Prentice Hall of India, 1988.

R2.B. Gottfired, "Schaum's Outline Series: Programming with C", 3rd Edition, McGraw Hill Publication, 2004.

H. Lecture Plan:

Lecture No.	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1.	Awareness with course objectives, outcomes and applications	Basic Terminology, Flow Chart Designing, Algorithm Writing Styles, Applications of an Algorithm	Practical Applications, Real world problems	[1101.1]	Mid Term - I End Term
2.	The von Neumann Architecture		Lecture	[1101.1]	Mid Term - I End Term
3.	Flowcharts and algorithms		Lecture & Activity	[1101.1]	Mid Term - I End Term
4.			Lecture	[1101.1]	Mid Term - I End Term
5.	Operating system fundamentals (Linux)	Basic terminology, examples and commands	Lecture & Problem Solving Practice	[1101.1]	Mid Term - I End Term
6.					
7.	Programs, assembly language, high level programming languages;	Discussion, examples and facts	Lecture & Problem Solving Practice	[1101.1]	Mid Term - I End Term
8.					
9.	Data types	Concept discussion, programming examples	Lecture & Problem Solving Practice	[1101.2]	Mid Term - I End Term
10.	Variables			[1101.2]	Mid Term - I End Term
11.	Operators			[1101.2]	Mid Term - I End Term
12.	Expressions	Concept discussion, programming examples	Lecture & Problem Solving Practice	[1101.2]	Mid Term - II End Term
13.	Statements		Lecture & Problem Solving Practice	[1101.2]	Mid Term - II End Term
14.	**Number System:** Binary, decimal, octal, hexadecimal	Concept discussion, number system conversion, programming examples	Lecture & Problem Solving Practice	[1101.3]	Mid Term - I End Term
15.					
16.					
17.					
18.					
19.					
20.	Control structures	Concept discussion, programming examples	Lecture & Problem Solving Practice	[1101.4]	Mid Term - II End Term
21.					
22.					
23.	Functions	Function writing, parameter passing, types of functions and their flexible use	Lecture & Problem Solving Practice	[1101.4]	Mid Term - II End Term
24.					
25.					
26.	Recursion, arrays	Recursive functions and parameter passing, array defining and use	Lecture & Problem Solving Practice	[1101.4]	Mid Term - II End Term
27.					
28.					
29.	Pointers	Dynamic use of memory address, pointer as array, function argument passing	Lecture & Problem Solving	[1101.4]	Mid Term - II End Term
30.					
31.					

32.		through pointers etc.	Practice		
33. 34. 35. 36.	Records (structures), files, input/output,	Data file creation, different types of file operations etc.	Lecture & Problem Solving Practice	[1101.4]	Mid Term - II End Term
37. 38. 39. 40. 41. 42.	Standard library functions and elementary data structures	Exploration of inbuilt library functions, user define data structures	Lecture & Problem Solving Practice	[1101.4]	Mid Term - II End Term

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

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CS1101.1	Described a deep knowledge of computer for better understanding of devices, basic fundamental of computer comprises in this course.	3	3							1	2		1	3	2		
CS1101.2	Design flow chart, Write algorithm and pseudo code parallel with Control Statements to understand flow of program execution.	2	2	1		1				1	1			3	1		
CS1101.3	Understand bitwise operations and conversion of numbers in different representations through Number System.	3	2	1							1			2	2	3	
CS1101.4	Developing skills in students to learn memory oriented operation using pointers and understating programming skills by Array, Structure, Union, Enum and String are added.	2	3	3						1	2	2	2	2	1		
CS1101.5	Students learned the concept of re-usability by means of functions in C and to illustrate the concept of data base using file handling.	2		2				1	1				1	1	1	3	3

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering
Department of Mechanical Engineering
Course Hand-out
Engineering Thermodynamics| ES 1103 | 3 Credits | 3 0 0 3
Session: July 18 – May. 19 | Faculty: Mr. Rahul Khatri | Class: B.Tech. I/II Semester

A. Introduction: Thermodynamics is a basic science that deals with equilibrium, energy and its transformation, and the laws governing such transformation. These laws are of wide applicability and are used in several branches of engineering and science. Principles and concepts of thermodynamics are important and indispensable tools in the innovation, design, development and improvement of engineering process, equipment and devices which deal with effective utilization of energy. Notable applications of engineering thermodynamics in the field of energy technology are: power producing devices, e.g., internal combustion engines and gas turbines, steam and nuclear power plant, power consuming devices, e.g., fans, blowers and compressors, refrigeration and air conditioning plants , chemical process plant and direct energy conversion devices. It is essential that every engineer should have a thorough knowledge of thermodynamics and hence thermodynamics has been an essential part of engineering curricula all over the world.

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

[ES1103.1] Understand the fundamental concepts of thermodynamics such as temperature, pressure, system, properties, process, state, cycles and equilibrium in the context of engineering applications.

[ES1103.2] Apply first law of thermodynamics on flow and non-flow processes.

[ES1103.3] Design and analyse the concept of components (compressor, turbine, pump, etc.) with the use of thermodynamic law to enhanced the skills for industrial applications.

[ES1103.4] Analyze the concept of second law and entropy in the context of thermal applications.

[ES1103.5] Apply the concept of first & second law of thermodynamics to design/utilize the power generating and power consuming devices.

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 under- standing 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.

Program Specific Outcomes:

PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software
[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels
[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

D. Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Open Book)	15
	Sessional Exam II (Open Book)	15
	Quizzes (Open Book/Close Book) and Assignments	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.	
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

Definitions & Concepts: SI Units; System, Thermodynamic Properties of Fluids: Mathematical, Tabular and Graphical representation of data; Ideal gas Van der Waals Equation of state; Compressibility chart; Thermodynamic Diagrams including Mollier diagram; Steam Tables. Zeroth Law of thermodynamics: temperature scale. First Law of Thermodynamics: Applications to Non flow processes, Applications of First Law of Thermodynamics of Flow Processes – Steady State / Transient; Applications of First Law of Thermodynamics to Chemically Reacting Systems. Second Law of Thermodynamics: Applications. Thermodynamic Relations: Thermodynamic Potentials, Maxwell's Relations; Availability. Power Cycles and Refrigeration Cycles, Gas-Vapor Mixtures and Psychrometry.

F. Text Book:

T1. An Introduction to Thermodynamics, YVC Rao, Universities Press (India) Private Limited, Revised Edition, 2004.

G. Reference Book:

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

H. Lecture Plan:

Lec No	**Topics**	**Session Objective**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing the Outcome**
1	Introduction to Thermodynamics	Know the basics of the course and understand its applications	Lecture	ES1103.1	Home Assignment and Class Quiz Mid-Term I End-Term
2	Concepts and Definitions- System, Surroundings, Intensive and Extensive Properties, Energy, Equilibrium	Discuss the terms system and surroundings, thermodynamic properties and describe their use	Lecture	ES1103.1	
3	Equilibrium, Stability, Process, Work	Understand the criteria of thermal equilibrium, mechanical equilibrium and chemical equilibrium	Lecture	ES1103.1	
4	Work, Definition of Thermodynamics, Modes of work, Heat	Brief about the thermodynamics definition of work, distinguish between heat and work and identify their effects	Lecture	ES1103.1	Home Assignment and Class Quiz Mid-Term I End-Term
5	Thermodynamic Properties of Fluids- Concepts of phases, Equations of state	Understand a pure substance and a phase and phase transformation	Lecture	ES1103.1	
6	Ideal gas, van der Waals equation, Critical constants	Understand the concept of ideal gas and van der Walls equation of state	Lecture	ES1103.1	
7	Other equations of state, Compressibility chart, Reduced equation of state, Generalized compressibility chart	Use of compressibility chart and generalized compressibility chart and its applications	Lecture	ES1103.1	Home Assignment and Class Quiz Mid-Term I End-Term
8	Graphical representation of data – T-V diagram, P-V diagram, P-T diagram, Mollier diagram	Understand various thermodynamic diagrams like T-v, P-v, P-T, and Mollier diagram	Lecture/Activity	ES1103.1	

9	Tabular representation of data, Steam table	Estimating the properties of steam using steam tables.	Lecture/Activity	ES1103.1	
10	Zeroth law of thermodynamics, First law of thermodynamics-History	Understand the Zeroth law of thermodynamics	Lecture	ES1103.1 ES1103.2	Home Assignment and Class Quiz Mid-Term I End-Term
11	First law of thermodynamics, Consequences, Analysis of elementary processes	Know the genesis of the first law of thermodynamics	Lecture	ES1103.2	
12	Analysis of elementary processes, Isothermal processes, Adiabatic processes, Polytropic processes	Apply the first law of thermodynamics to analyse different thermodynamics process	Lecture	ES1103.1 ES1103.2	
13	Constant internal energy processes	Apply the first law of thermodynamics to analyse constant internal energy process	Lecture	ES1103.1 ES1103.2	Home Assignment and Class Quiz Mid-Term I End-Term
14	First law analysis of processes – Control mass analysis, Control volume analysis	Explain the control mass and control volume analysis	Lecture	ES1103.2 ES1103.3	
15	Applications of steady state flow processes, Throttling process, Applications of throttling	Analyse the steady flow processes and its applications	Lecture	ES1103.2 ES1103.3	
16	Transient flow processes, Case of an ideal gas	Analyse the transient flow processes.	Lecture	ES1103.1 ES1103.2 ES1103.3	Home Assignment and Class Quiz Mid-Term II End-Term
17 & 18	Second law of thermodynamics- Heat engine, Heat pump or refrigerator, Second law of thermodynamics	Understand the concept of second law and its requirement	Lecture/Lab Visit	ES1103.4	
18	Kelvin, Plank, and Clausius statement, Reversible and Irreversible reactions, Criteria for irreversible processes	Understand the statements of second law of thermodynamics and also discuss the criteria for irreversible process	Lecture	ES1103.4	

20	Carnot cycle, Carnot theorem, Thermodynamic temperature scale	Understand the Carnot cycle and its use in thermodynamics	Lecture	ES1103.4	Home Assignment and Class Quiz Mid-Term II
21	Clausius inequality, Entropy, Calculation of entropy change	State the Clausius inequality and calculate the entropy change of the system	Lecture	ES1103.4	End-Term
22	Principles of entropy increase, Temperature-entropy diagram	Understand the principles of entropy increase and its reason	Lecture	ES1103.4	
22	Available energy, Loss in available energy,	Define the available and unavailable energy through the concept of second law	Lecture	ES1103.4	Home Assignment and Class Quiz Mid-Term II
23	Availability and Irreversibility	Estimate the loss in available energy in a given process	Lecture	ES1103.4	End-Term
24	Thermodynamic relations-Maxwell's relations, Mnemonic diagram, Thermodynamic potentials	Understand the importance the Maxwell's relations	Lecture	ES1103.3 ES1103.4	
25	Thermodynamic potentials, Mathematical preliminaries, Entropy relations	Know the thermodynamic potentials	Self-Study	ES1103.3 ES1103.4	Home Assignment and Class Quiz Mid-Term II
26	Joule-Thompson coefficient, Clapyeron equation, Gibb's phase rule	Understand the Joule-Thompson coefficient, Clapyeron equation, Gibb's phase rule	Lecture	ES1103.3 ES1103.4	End-Term
27	Power and Refrigeration cycles-Classification, Vapor power cycles, Carnot vapor power cycle,	Classify the power cycles into vapour cycles and gas power cycles	Lecture	ES1103.1 ES1103.3 ES1103.5	Home Assignment and Class Quiz End-Term
28	Ideal Rankine cycle and practical Rankine cycle	Explain the basics of Rankine cycle and estimate the thermal efficiency of an Ideal and actual Rankine cycle	Lecture	ES1103.1 ES1103.3 ES1103.5	
29 &30	Gas power cycles, Otto cycle, Diesel cycle	Analyse the Otto and diesel cycle	Lecture/Lab Visit	ES1103.1 ES1103.3 ES1103.5	

31	Comparison of Otto and Diesel cycle, Air standard dual cycle	Analyse the differences in Otto, Diesel and dual cycle	Lecture	ES1103.1 ES1103.3 ES1103.5	Home Assignment and Class Quiz End-Term
32	Ideal and Actual Brayton cycle	Analyse air standard Brayton cycle	Lecture	ES1103.1 ES1103.3 ES1103.5	
33 &34	Refrigeration cycle, Vapor compression refrigeration cycle	Understand the practical refrigeration cycle and its components	Lecture/Lab Visit	ES1103.1 ES1103.3 ES1103.5	
35	Refrigerants, Gas refrigeration cycle	Know the criteria in selection of refrigerants and their use	Self-study	ES1103.1 ES1103.3 ES1103.5	Home Assignment and Class Quiz End-Term
36	Gas vapor mixtures and Psychrometry, ideal gas mixtures	Predict the properties of an ideal gas mixture from knowledge of the properties of the constituent species	Lecture	ES1103.1 ES1103.2 ES1103.5	
37	Psychrometer, Psychrometric chart	Use the psychrometric charts in the analysis of process of dealing with air-water vapour mixtures	Activity	ES1103.1 3 ES1103.5	

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
ES1103.1	Understand the fundamental concepts of thermodynamics such as temperature, pressure, system, properties, process, state, cycles and equilibrium in the context of engineering applications.	3													1	
ES1103.2	Apply first law of thermodynamics on flow and non-flow processes.	3	2													
ES1103.3	Design and analyse the concept of components (compressor, turbine, pump, etc.) with the use of thermodynamic law to enhanced the **skills** for industrial applications. ,	3		3	2										1	
ES1103.4	Analyse the concept of second law and entropy in the context of thermal applications	3	2	3	2		2	2							1	
ES1103.5	Apply the concept of first & second law of thermodynamics to design/utilize the power generating and power consuming Devices.	3	3	3			2	2							1	

MANIPAL UNIVERSITY JAIPUR

Course Hand-out

History of Indian Science and Technology | HS1102 | 2 Credits| 2 0 0 2

Session

Session: July-Dec. 2018 | Faculty Coordinator- Dr Arun Kumar Poonia| Class: B.Tech 1st Year Sem I/II

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

[HS1102.1] Identify the contribution of India in the field of science and technology.
[HS1102.2] Understand the contribution of ancient Indians in the field of science and technology for answering general knowledge questions during interviews for future employment
[HS1102.3] Analyse ancient Indian education system and reasons for its going into oblivion.
[HS1102.4] Examine the growth of Indian science and technology in the 20th century A.D.

B. 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 under- standing 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.

PROGRAM SPECIFIC OUTCOMES:

[PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software
[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels
[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	15
	Sessional Exam II (Close Book)	15
	Quizzes	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.	

D. SYLLABUS

An introduction and need to learn History of Indian science and technology; Early civilizations and their impact on development of science and technology; Contribution of Indian science and technology in the fields of mathematics, astronomy, medical science, architecture, metallurgy, agriculture, yoga; Discoveries and inventions; Indian education system; Possible reasons of oblivion; Effect of historical developments (pre and post-independence era), Policy measures; Case studies.

E. TEXT BOOKS

1. Lecture notes

F. REFERENCE BOOKS

R1. Indian Science and Technology in Eighteenth century, Dharampal, reprint of first edition (1983), Academy of Gandhian Studies, Hyderabad

R2. The Beautiful Tree: Indigenous Indian Education in the Eighteenth century, Dharampal, second edition (1995) Keerthi Publishing house, Coimbatore

R3.India's Glorious Scientific Tradition, Suresh Soni, first edition (2008) Prabhat Prakashan

G. Lecture Plan:

Lecture No	Topics	Session Objective	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction to the subject	To acquaint and clear teacher's expectations and understand students' expectations.	Lecture, Discussion	1102.1	Quizzes, 1st Sessional, End Term Examination
2	Why History to Engineers?	To ascertain the interest and the understanding of the students with focus on the need of this subject for them and its connection with the existing knowledge.	Lecture, Discussion	1102.1	Quizzes, 1st Sessional, End Term Examination
3	A Brief overview of India's contribution in Various Fields of Studies- I	To know about the scientific developments of the period. To know about the concepts of science, maths, technology, etc. used in the ancient times. To know about the major works of ancient Indians in the field of Science and Maths.	Discussion, Video	1102.1	Quizzes, 1st Sessional, End Term Examination
4	A Brief overview of India's contribution in Various Fields of Studies – II	To know about the scientific developments of the period. To know about the concepts of science, maths, technology, medicine, surgery, language, etc. in the ancient times. To know about the major works of ancient Indians in various fields of studies.	Lecture, PPT, Discussion	1102.1	Quizzes, 1st Sessional, End Term Examination
5	Ancient Civilizations and	To know about the development and	PPT, Videos	1102.1	Quizzes, 1st Sessional,

	Science & Technology- With focus on Indus Valley Civilization	extent of Indus Valley Civilization. To know about the use of concepts of science & technology in Indus Valley Civilization.			End Term Examination
6	Detailed Study about some aspects of Indus Valley Civilization	To know about the town planning/buildings/structures of Indus Valley Civilization. To know and study in detail about the city of Lothal and Harappa.	Lecture, PPT, Discussion	1102.2	Quizzes, 1st Sessional, End Term Examination
7	Ancient Indian Education System-1	To know about the educational system of ancient India. To know about the major fields of studies.	Lecture, PPT	1102.3	Quizzes, 1st Sessional, End Term Examination
8	Ancient Indian Education System-2	To know more about the educational system of ancient India. To know about the major fields of studies.	Discussion	1102.3	Quizzes, 1st Sessional, End Term Examination
9	Our ancient Universities- Nalanda and Takshila	To know about the educational system followed at these Universities and the scholars of those times. To know about the major fields of studies offered in these Universities.	PPT, Video	1102.3	Quizzes, 1st Sessional, End Term Examination
10	Probable Reasons for oblivion	To know about the probable reasons that led to the decline/fall of Indian education system.	Discussion	1102.3	Quizzes, 1st Sessional, End Term Examination
11	Contribution of India in the field of mathematics-1	Significant contributions and achievements of ancient Indian mathematicians in comparison to the rest of the world.	Videos, PPTs	1102.2	Quizzes, 2 Sessional, End Term Examination
12	Contribution of India in the field of mathematics-2	Significant contributions and achievements of ancient Indian mathematicians in comparison to the rest of the world.	Discussion	1102.2	Quizzes, 2 Sessional, End Term Examination

13	Contribution of India in the field of Astronomy- 1	Significant contributions and achievements of ancient Indian in the field of astronomy.	Videos, PPTs	1102.1	Quizzes, 2 Sessional, End Term Examination
14	Contribution of India in the field of Astronomy- 2	Significant contributions and achievements of ancient Indian in the field of astronomy.	Discussion	1102.1	Quizzes, 2 Sessional, End Term Examination
15	Contribution of India in the field of Architecture- 1	To look into the architectural heritage of India.	Videos and PPTs	1102.2	Quizzes, 2 Sessional, End Term Examination
16	Contribution of India in the field of Architecture- 2	To look into the architectural heritage of India.	Discussion	1102.2	Quizzes, 2 Sessional, End Term Examination
17	Contribution of India in the field of Metallurgy- 1	Significant contributions and achievements of ancient Indian metallurgists in comparison to the rest of the world.	Lecture	1102.1	Quizzes, 2 Sessional, End Term Examination
18	Contribution of India in the field of Metallurgy- 2, with special reference about Wootz steel.	A discussion on pioneering steel alloy matrix developed in India called Wootz steel and achievements of India in Zinc smelting by distillation process, first in the world	Lecture	1102.1	Quizzes, 2 Sessional, End Term Examination
19	Contribution of India in the field of Yoga and medicine- 1	Contribution of Indian scientists in plastic surgery and cataract surgery with reference to Sushruta Samhita, Jabamukhi Salaka etc.,	Lecture	1102.2	Quizzes, End Term Examination
20	Contribution of India in the field of Yoga and medicine- 2	Discussion on father of Indian medicine, Charkha and his contributions to ancient science of Ayurveda (Charakhasamhita)	Lecture	1102.2	Quizzes, End Term Examination
21	Indian Science & Technology in 20th Century- Major achievements	Major developments and achievements by indian scientists and researchers.	Lecture	1102.1, 1102.4	Quizzes, End Term Examination
22	Indian Science &	To understand the	Lecture	1102.4	Quizzes,

	Technology in 20th Century- Institutionalization of science	establishment of the scientific and technological institutes and the gradual proliferation of the scientific bodies and societies.			End Term Examination
23	Indian Science & Technology after Independence- Scientific internationalism and the Institute that Bhabha built	Understand the robust internationalism and mapping out colonial structures and institutional history of the Tata Institute of Fundamental Research.	Lecture	1102.4	Quizzes, End Term Examination
24	Indian Science & Technology after Independence- Biotechnology in India	Realising the adoption of modern biology and biotechnology including early phase of Department of Biotechnology (DBT), established in 1986.	Lecture	1102.4	Quizzes, End Term Examination
25	Case Study- Jantar-Mantar (Jaipur)			1102.2	End Term Examination
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H. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	Correlation with Program Outcomes (POs)											
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
HS1102.1	Identify the contribution of India in the field of science and technology.	1					1	1					1
HS1102.2	Understand the contribution of ancient Indians in the field of science and technology.	1					1	1					
HS1102.3	Analyse ancient Indian education system and reasons for its going into oblivion.	0					1		1				
HS1102.4	Examine the growth of Indian science and technology in the 20th century A.D.	1					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

TECHNICAL COMMUNICATION | EN1111 | 3 Credits | 2 1 0 3

Session: July.2018– May 2019 | Faculty: Dr Richa Arora | Class: B. TECH. I YEAR Sem :I/II

A. Introduction: This course is offered by Department of Languages as a compulsory course to the students of B.Tech in I and II Semester. The course offers in-depth knowledge of fundamental principles of effective communication skills. The course aims to develop critical and creative thinking abilities for communicative competence. It aims to organize and express ideas clearly in speech.

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

[EN1111.1] Review communication as a process with greater awareness
[EN1111.2] Display enhanced competence in oral and written communication
[EN1111.3] Use appropriate communication skills in specific contexts and for specific purposes
[EN1111.4] Demonstrate meaningful group communication exchanges

[EN1111.5]] Frame questions to elicit the desired response and respond appropriately to questions which will lead them towards employability.

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 syn thesis 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 under- standing 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.

PROGRAM SPECIFIC OUTCOMES:

[PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software
[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels
[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

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 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 participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS

Effective Pronunciation: Understanding English sounds and their symbols, phonemic transcriptions, characteristics of language; **Effective Communication Skills (LSRW- Listening, Speaking, Reading and Writing):** Definition, process, types, barriers, non-verbal communication, kinesics & paralanguage, difference between general and technical communication, difference between hearing and listening; **Common errors in professional English**: Prepositions, articles, non-finite verbs, syntactic errors & words often confused (nouns, verbs, adjectives & adverbs), sentence pattern, question tags, synonyms, antonyms, one word substitutions; **Compositional Skills**: Reading comprehension, paragraph writing: different orders of paragraph writing, précis writing, formal letter writing, job application & resume writing, email etiquettes, technical writing, **writing a movie review in English**; **Classroom Activity:** Group Discussion; Mock Interview; Understanding nuances of delivery for making presentations and impromptu public speaking; **Literary texts for Case Studies.**

F. TEXT & Reference Books

T1.C Tickoo and J Sasikumar. *Writing with a Purpose.* New Delhi: Oxford University Press, 2000.

T2. D Green. *Contemporary English Grammar, Structures and Composition* . Delhi: Macmillan Publications, 2000.

T3. D Jones. *English Pronouncing Dictionary*. London: ELBS, 2003.

T4. L Bauer. *An Introduction to International Varieties of English*. Edinburgh: Edinburgh University Press, 2002.

T5. M M McCarthy. *English Idioms in Use*. London: Cambridge University Press, 2002.

T6. M Raman and S Sharma. *Technical Communication: Principles and Practice 2/e*. New Delhi: Oxford University Press, 2013.

T7. N D Burton and J B Heaton. *Longman Dictionary of Common Errors*. Harlow: Longman, 1998.

T8. N Ezekiel. *Collected Poems*. New Delhi: OUP, 2006.

R1. N Krishnaswamy. *Modern English: A Book of Grammar Usage and Composition* . Delhi: Macmillan India, 2000.

R2 R Parthasarthy (ed.). *Ten Twentieth Century Indian Poets*. New Delhi: OUP, 2009.

R3. S Mishra and C Muralikrishna. *Communication Skills for Engineers*. New Delhi: Pearson Education, 2010.

G. Lecture Plan

DAY	TOPICS	Programme objective	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
Day 1	Introduction to Communication Skills- LSRW; Definition and process of Communication	Communicate Effectively & Life long learning	Lecture, PPT, Discussion	1111.1	Quizzes, 2 Sessional, End Term Examination
Day 2	Types of Communication features of Communication;	Communicate Effectively& Lifelong learning	Lecture, PPT, Discussion	1111.1	Quizzes, 2 Sessional, End Term Examination
Day 3	Barriers to Communication	Communicate Effectively& Lifelong learning	Lecture, PPT, Discussion	1111.1	Quizzes, 2 Sessional, End Term Examination
Day 4	Verbal and Non-verbal communication	Communicate Effectively& Lifelong learning	Lecture, PPT, Discussion	1111.1	Quizzes, 2 Sessional, End Term Examination
Day 5-6	Difference between General and Technical communication; Revision and Recapitulation of	Communicate Effectively& Lifelong	Lecture, PPT, Discussion and problem solving	1111.3	Quizzes, 2 Sessional, End Term

	Communication Theory with practical specimens	learning			Examination
Day 6	Introduction to the basics of English Grammar; Subject-Verb Agreement	Communicate Effectively& Lifelong learning	Lecture, PPT,	1111.2,1111.4	Quizzes, 2 Sessional, End Term Examination
Day 7	Common errors and misappropriations in English	Communicate Effectively& Lifelong learning	Lecture	1111.4	Quizzes, 2 Sessional, End Term Examination
Day 8	Change of Voice	Communicate Effectively& Lifelong learning	Lecture, PPT, Discussion, Exercise	1111.5	Quizzes, 2 Sessional, End Term Examination
Day 9	Determiners and Modals	Communicate Effectively& Lifelong learning	Lecture, PPT, Exercise	1111.5	Quizzes, 2 Sessional, End Term Examination
Day 10-12	Jumbled up sentences and Grammar Practice	Communicate Effectively& Lifelong learning	Lecture, PPT, Exercise	1111.5	Quizzes, 2 Sessional, End Term Examination
Day 13	Distinction between hearing and listening; Types of Listening	Communicate Effectively& Lifelong learning	Exercise	1111.2,1111.4	Quizzes, 2 Sessional, End Term Examination
Day 14	Barriers to effective listening	Communicate Effectively& Lifelong learning	Lecture, PPT, Exercise with audio files	1111.2,1111.4	Quizzes, 2 Sessional, End Term Examination
Day 15	Skills to comprehend conversations and lectures	Communicate Effectively& Lifelong learning	Lecture, PPT, Discussion	1111.2,1111.4	Quizzes, 2 Sessional, End Term Examination
Day 16-18	Role of pronunciation, accent, intonation and voice modulation	Communicate Effectively& Lifelong learning	Videos	1111.2,1111.4	Quizzes, 2 Sessional, End Term Examination
Day 19-20	Practical specimens of correct pronunciation, accent, intonation and voice modulation	Communicate Effectively& Lifelong learning	Practice with video files	1111.2,1111.4	Quizzes, 2 Sessional, End Term Examination
Day 21	Reading Comprehension- An Introduction	Communicate Effectively& Lifelong learning	Lecture, PPT	1111.2,	Quizzes, 2 Sessional, End Term Examination
Day 22	Skimming and Scanning for Reading Comprehension	Communicate Effectively& Lifelong learning	Lecture, PPT, Practice with texts	1111.2	Quizzes, 2 Sessional, End Term Examination
Day 23-24	Lexical and Contextual Meaning in Reading Comprehension	Communicate Effectively& Lifelong learning	Lecture, PPT, practice with texts	1111.2	Quizzes, 2 Sessional, End Term Examination
Day 25	Learning Advanced Vocabulary	Communicate Effectively& Lifelong learning	Worksheet & Exercise	1111.3,1111.4	Quizzes, 2 Sessional, End Term Examination

Day 26	Learning profession specific advance vocabulary	Communicate Effectively& Lifelong learning	Worksheet & Exercise	1111.3,1111.4	Quizzes, 2 Sessional, End Term Examination
Day 27	Introduction to Writing Skills	Communicate Effectively& Lifelong learning	Lecture, PPT,	1111.5	Quizzes, 2 Sessional, End Term Examination
Day 28-29	Précis writing- Theory and practice	Communicate Effectively& Lifelong learning	Lecture, PPT, Exercise	1111.5	Quizzes, 2 Sessional, End Term Examination
Day 30-31	Writing of Technical Reports- Theory	Communicate Effectively& Lifelong learning	Lecture, PPT,	1111.5	Quizzes, 2 Sessional, End Term Examination
Day 32	Formal letter writing- Basics and Practice	Communicate Effectively& Lifelong learning	Lecture, PPT, Home Assignments	1111.5	Quizzes, 2 Sessional, End Term Examination
Day 33	Email Writing- Theory, Practice and etiquette	Communicate Effectively& Lifelong learning	Lecture, PPT, GD	1111.5	Quizzes, 2 Sessional, End Term Examination
Day 34	Resume writing- Theory and Practice	Communicate Effectively& Lifelong learning	Lecture, PPT, Exercise	1111.5	Quizzes, 2 Sessional, End Term Examination
Day 35	Job application & Cover letters- Practice	Communicate Effectively& Lifelong learning	Lecture, Exercise	1111.5	Quizzes, 2 Sessional, End Term Examination
Day 36	Content writing for brochures and websites; Writing Biographical Sketch; Writing Statement of Purpose	Communicate Effectively& Lifelong learning	Lecture, PPT, Exercise	1111.3,1111.5	Quizzes, 2 Sessional, End Term Examination
Day 37	Group Discussion- Theory and Types; Practice	Communicate Effectively& Lifelong learning	Exercise	1111.2,1111.4	Quizzes, 2 Sessional, End Term Examination
Day 38-39	Interview Types, Questions and Etiquettes; Mock Interviews	Communicate Effectively& Lifelong learning	PPT, GD	1111.3	Quizzes, 2 Sessional, End Term Examination
Day 40	Analysing Case Study and its Practice	contextual knowledge to assess societal, health, safety, legal, and cultural issues	PPT, GD	1111.2	Quizzes, 2 Sessional, End Term Examination
Day 41	PowerPoint Presentations	Communicate Effectively	PPT, GD	1111.2	Quizzes, 2 Sessional, End Term Examination
Day 42	PowerPoint Presentations	Communicate Effectively	PPT, GD	1111.2	Quizzes, 2 Sessional, End Term Examination

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

CO	STATEMENT	Correlation with Program Outcomes (POs)												Correlation with Program Specific Outcomes (PSOs)		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO 2**	**PSO 3**
[1111.1]	Review communication as a process with greater awareness	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0
[1111.2]	Display enhanced competence in oral and written communication	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
[1111.3]	Use appropriate communication skills in specific contexts and for specific purposes	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
[1111.4]	Demonstrate meaningful group communication exchanges	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
[1111.5]	Write well organized self-introduction, CV, Resume etc. as required in profession	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile, Mechanical & Mechatronics

Department of Mechanical Engineering

Course Hand-out

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

Session: Jul 18 – Dec 18 | Faculty: Dr.Varuni Sharma | Class: B. Tech | Semester III

A. Introduction: This course is offered by Dept. of Economics to the Engineering departments, targeting students to give **b**asic understanding in the concept of economics. It mainly deals with economic issues related to consumer behavior, industries and business organizations to make aware the students regarding economic environment.

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

[EO1323.1] Describe the basic principles of micro and macro-economic analysis.

[EO1323.2] Interpret and illustrate decision making process in practical life.

[EO1323.3] Aware of the tools and techniques of economics for real world.

[EO1323.4] Recognize the problems and give solutions for employability.

[EO1323.5] 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 engineer ing 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 professiona l 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 sustainab le development

[PO.8]. **Ethics**: Apply ethical principles and commit to professionalethics 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 engineer ing 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

PROGRAM SPECIFIC OUTCOMES

[PSO.1]. **Modelling & Analysis**: Model and analyze mechanical engineering components using advanced software.

[PSO.2]. **Alternative fuels**: Analyze performance of I. C. engines attributed to alternate fuels.

[PSO.3]. **Synthesis and Manufacturing**: Synthesize Advance Materials and Manufacture components and spares.

D. Assessment Plan:

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.	

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

T1. P. Samuelson and Nordhaus, Economics, 19th Edition, Tata McGraw-Hill, 2008.
T2. Dornbusch, Fischer and Startz, Macroeconomics, McGraw Hill, 2010

G. REFERENCE BOOKS

- R1. P L Mehta, Managerial EconomicsS Chand and company pvt. limited, New Delhi, 2012
- R5. Richard T. Froyen, Macroeconomics, Pearson Education Asia, 2005

G. Lecture Plan:

LEC NO	TOPICS
1	Overview of the course structure
2	Objective of the course
3,4	Definition, nature and scope of economics, introduction to micro and macroeconomic s
5,6,7,	Cardinal approaches of utility
8,9,10,11	Law of demand and supply, elasticity of demand and supply
12	Revision of previous lectures
13	Discussion of the topics related to assignment
14,15,16	Ordinal approaches of utility
17,18,19	Production, laws of production
20,21	Cost and revenue analysis;
22,23	Various market situations; Break even analysis
24	Revision of previous lectures
25	Discussion of the topics related to assignment
26	Capital budgeting
27,28	Macro Economics: National income and its concepts
29,30	value of money and its changes; foreign exchange rate;
31,32	monetary and fiscal policies
33,34	Inflation
35	Various macro concepts: Balance of payments, Business cycles
36,37	Discussion of the topics related to internal assessment
38,39	Revision of previous lectures

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

I.

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EO 1323.1	Describe the basic principles of micro and macroeconomic analysis									1		2	2			1
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									2		2	2			2

	to it															
EO 1323.5	Recall the assumptions that underpin the Micro/Macro model.									2			3			1

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile, Mechanical & Mechatronics
Department of Mechanical Engineering
Course Hand-out
Engineering Mathematics III | MA 1313 | 3 Credits
Session: July18-December 18 | Faculty: Dr. Ram Naresh Saraswat/Dr. Laxmi Poonia Class: B. Tech | Semester III

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

[MA1313.1] Analysis the problems of engineering by using Numerical analysis for analytical skills.
[MA1313.2] Solve the differential equations by using Laplace and Fourier transform.
[MA1313.3] Study the Flux and motion of fluid in the vector field.
[MA1313.4] 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.

PROGRAM SPECIFIC OUTCOMES

[PSO.1]. Modelling & Analysis: Model and analyze mechanical engineering components using advanced software.

[PSO.2]. Alternative fuels: Analyze performance of I. C. engines attributed to alternate fuels.

[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

F. 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 assignme nts	

G. 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 coefficie nts.

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 interpolatio n formula, Lagrange's and Stirling interpolation formula. Numerical differentiation and integration.

Text Books:

T1. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, Delhi, 2006.

T2. Srimanta Pal, Subhdh C. Bhunia, "Engineering Mathematics", Oxford University Press, 2015.

T3. H. K. Das, "Advanced Engineering Mathematics" S. Chand, 2015.

References:

R1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India Eastern, 2006.

R2. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill Education Private Limited, New Delhi 2007.

H. Lecture Plan:

Description of the Topics	**Require d Lectures**	**Cumulated Lectures**
Laplace Transform:		
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
Finite Differences and Interpolation		
Finite difference operators	1	8
Newton's- Gregory forward and backword 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
Vector Calculus:		

gradient, divergence and curl	3	20
vector integrals	3	23
Greens, Stokes and Gauss Divergence theorem	4	27
Fourier series:		
Fourier series, Dirichlet Condition	2	29
even and odd functions half range series	1	30
change of interval	2	32
Harmonic analysis	2	34
Fourier Transforms:		
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

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
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 Attainment; 2- Moderate Attainment; 3- Substantial Attainment

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering
Department of Mechanical Engineering
Course Hand-out
Material Science and Engineering | ME 1301 | 3 Credits | 3 0 0 3
Session: July 18 – December18 | Faculty: Dr. Sanchita Bandyopadhyay -Ghosh | Class: B.Tech Semester III

A. INTRODUCTION: This course is offered by Department of Mechanical Engineering as programme elective. This course aims to provide a physical basis that links the structure of materials with their properties. Emphasis will be on the "processing, structure, properties, and performance" relationships that lead to the development of materials for society's needs. This course will expose the students to different classes of materials, their properties, structures and imperfections present in them. It will help understand the subject with ease by presenting the content in a simplified and logical sequence. It will aid the teaching learning process through relevant illustrations, animations,web content and practical examples. The course will highlight important concepts for each topic covered in the subject. Finally this course will provide opportunity of self-evaluation on the understanding of the subject matter.

B. COURSE OUTCOMES: At the end of the course, students will

[ME1301.1] The aim is to explain the basic fundamentals of materials science and engineering.
[ME1301.2] Structure of crystalline solids, crystallography, lattice imperfections, and their effects on structure and related properties will be discussed**.**
[ME1301.3] Students can able to learn materials acquire knowledge about failure phenomena, mechanical testing, interpretation of test results, concept of phase transformation, phase diagrams and its influence on properties of engineering materials will be highlighted benefitted for improving research skills.
[ME1301.4] This course will also combine traditional instruction in ceramic, metallurgy, polymer and fibre science and engineering with modern materials, including nano-, bio-, composite, smart materials, their stricture-property correlations, and 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, cultura l, 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.

PROGRAM SPECIFIC OUTCOMES

[PSO.1]. Modelling & Analysis: Model and analyze mechanical engineering components using advanced software.

[PSO.2]. Alternative fuels: Analyze performance of I. C. engines attributed to alternate fuels.

[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

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 Materials Science and Engineering: Materials classification. Crystallography SC, FCC, BCC, HCP structures, APF; Miller indices: Crystal structure determination-X-ray diffraction techniques, Microscopic examination; Imperfections in Crystals: Point defects, line defects, surface defects. Plastic Deformation of Metals and Alloys, Mechanisms of plastic deformation, role of Dislocation; slip and twinning, grain growth, Solidification of Metals and Alloys: Solid solution, Hume Rothery's rules, Phase diagrams- Phase and Lever Rules relationship of micro Structure and properties, Iron- Carbon equilibrium diagram, Development of microstructure in Iron Carbon alloys, Phase transformation Mechanical Properties of Metals; Fatigue and Failure of materials: S-N Curve, Fatigue life methods of improving fatigue strength, Fatigue failure

Polymers and applications: Types of polymers, structure and applications; Hydrocarbon and polymer molecules, Molecular weight, shape, structure and configurations, Thermosetting and thermoplastic polymers; Characteristics and Applications of Polymers; Mechanical behavior of polymers, mechanisms of deformation; Crystallization, Melting, and Glass transition phenomena, Application and Properties of Ceramics: Types and applications of ceramics; Ceramic manufacturing; Mechanical and other properties.

Fabrication of Plastics, Fibres and Films; Composites Materials: FRP, MMC, PMC and other types and applications; Fibre, Particle reinforced composites, Structural composites; Biocomposites, Nanocomposites, Composite micromechanics.

Advanced Materials: Smart materials, Biomaterials, Nanomaterials.

Prescribed Text Book

T1. Callister William D & R. Balasubramaniam, Materials Science and Engineering, Wiley Student Edition, 7th Edition, 2007.

Reference Books

R1. William F Smith, Javad Hashmi and Ravi Prakash, Materials Science and Engineering, Fourth Edition, Tata Mcgraw Hill Education Private Limited, New Delhi.

R2. George E. Dieter, Mechanical Metallurgy, SI Metric Edition McGraw Hill Book Company, London.

R3. R. A. Higgins, Applied Physical Metallurgy, Sixth edition, Viva Low priced students edition, New Delhi.

R4. Thomas. H. Courtney, "Mechanical Behaviour of Materials", McGraw Hill Publication company, Materials Science series, II Edition, 2000.

F. LECTURE PLAN

Lecture	Topic	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
L1	Introduction, Scope and Objectives of the Course	To acquaint And clear teachers expectations and Understand student expectations	Lecture/PPT	[ME1301.1]	NA
L2	Classification of Engineering Materials and Applications	Students will understand the importance of 'Engineering Materials'	Lecture/PPT	[ME1301.1]	Mid-Term 1 Quiz
L3	Atomic Structure and Electron Configuration	Students will be able to Understand fundamentall structure of materials	Lecture/PPT	[ME1301.2]	Quiz
L4	Interatomic Bonding	Different bonding aspects	Lecture/PPT	[ME1301.2]	Mid-Term 1 Quiz
L5	Concepts Check, Numericals, Problem Solving	Problem Solving	Lecture/PPT	[ME1301.2]	Assignment
L6	The Structure of Crystalline Solids	Discuss different types of crystal structures	Lecture/PPT	[ME1301.2]	Mid-Term 1 Quiz
L7	Crystallography, SC, FCC, BCC, HCP Structure	Understand in detail about various crystal structures	Lecture/PPT	[ME1301.3]	Mid-Term 1
L8	Miller Indices, Application for Planes and Directions	Students will understand Assignment Of crystal structures and notations	Lecture/PPT	[ME1301.3]	Quiz
L9	Concepts Check, Numericals, Problem Solving	Problem Solving	Lecture/PPT	[ME1301.3]	Mid-Term 1
L10	Imperfections in Solids	Students will understand about various defects and their effects.	Lecture/PPT	[ME1301.3]	Quiz
L11	Dislocations, Types and Influence on Mechanical Properties	Students will understand effect of dislocations and their effects.	Lecture/PPT	[ME1301.3]	Mid-Term 1 Quiz
L12	Concepts Check, Numericals, Problem Solving	Problem Solving.	Lecture/PPT	[ME1301.3]	Mid-Term 1 Quiz
L13	Mechanical Properties of Materials	Describe mechanic a l properties of metals	Lecture/PPT	[ME1301.3]	Mid-Term 1 Quiz

L14	Fatigue and Failure of materials	Fatigue and failure properties of metals.	Lecture/PPT	[ME1301.3]	Mid-Term 1 Quiz
L15	Characterization Techniques of Materials	Learn about various characterization techniques.	Lecture/PPT	[ME1301.3]	Mid-Term 1 Quiz
L16	Concepts Check, Numericals, Problem Solving	Problem Solving	Lecture/PPT	[ME1301.3]	Mid-Term 1 Quiz
L17	Quiz 1 and Assignment topics	Learn about overall mechanical performance	Lecture/PPT	[ME1301.3]	Quiz
L18	Solidification of Metals and Alloys	Describe various solidification processes.	Lecture/PPT	[ME1301.3]	Quiz & Assignment
L19	Phase Diagrams: Introduction and Basic Concepts	Understand importance of phase diagrams	Lecture/PPT	[ME1301.3]	Mid-Term 2
L20	Binary Phase Diagrams	Learn about binary phase diagrams	Lecture/PPT	[ME1301.3]	Mid-Term 2
L21	Iron-Carbon System	Learn about various iron-carbon system.	Lecture/PPT	[ME1301.3]	Quiz
L22	Concepts Check, Numericals, Problem Solving	Problem Solving.	Lecture/PPT	[ME1301.3]	Mid-Term 2
L23	Fabrication of Metals	Understand various metal fabrication techniques.	Lecture/PPT	[ME1301.3]	Mid-Term 2
L24	Ceramics and Glasses	Understand various types of ceramics glasses	Lecture/PPT	[ME1301.3]	Mid-Term 2
L25	Structure and Properties of Ceramics	Learn about various structures and properties of ceramics.	Lecture/PPT	[ME1301.3]	Assignment & Discussion
L26	Ceramic Manufacturing	Learn about various manufacturing processes	Lecture/PPT	[ME1301.3]	Mid-Term 2 Quiz
L27	Applications and Processing of Ceramics	Learn applications and processing	Lecture/PPT	[ME1301.3]	Mid-Term 2
L28	Polymers and Elastomers	Describe various mechanical properties of nanoparticles	Lecture/PPT	[ME1301.3]	Mid-Term 2 Quiz
L29	Structures of Polymers	Understand importance of optical properties and possible areas of applications.	Lecture/PPT	[ME1301.3]	Quiz
L30	Processing, Characteristics, and	Describe various electrica l properties	Lecture/PPT	[ME1301.3]	Assignment & Discussion

	Applications of Polymers				
L31	Mechanical and Thermal Properties of Polymers	Identify carbon nanoparticles and their applications	Lecture/PPT	[ME1301.3]	Mid-Term 2 Quiz
L32	Fabrication of Plastics, Fibres and Films	Identify non-carbon nanoparticles and their applications	Lecture/PPT	[ME1301.3]	Mid-Term 2 Quiz
L33	Composites Materials: Classification	Identify Various safety concerns and toxicologic a l effects	Lecture/PPT	[ME1301.4]	Mid-Term Quiz
L34	Structure, Properties and Applications of Composites	Identify various environmental concerns	Lecture/PPT	[ME1301.4]	Mid-Term 2
L35	Fabrication of Composites Characterization of Composites	Identify and discuss application areas of nanotechnology	Lecture/PPT	[ME1301.4]	Mid-Term 2 Quiz
L36	Biocomposites and Bioplastics	Identify and discuss application areas of nanotechnology	Lecture/PPT	[ME1301.4]	Mid-Term 2
L37	Smart Materials: Types and Applications	Identify and discuss application areas of smart materials	Lecture/PPT	[ME1301.4]	Mid-Term 2 Quiz
L38	Biomaterials: Structure, Properties and Applications	Identify and discuss application areas of Biomaterials	Lecture/PPT	[ME1301.4]	Mid-Term 2
L39	Nanomaterials: Structure, Properties and Applications	Identify and discuss application areas of nanomaterials	Lecture/PPT	[ME1301.4]	Mid-Term 2
L40	Quiz -2	QUIZ	Lecture/PPT	[ME1301.4]	Quiz

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
[1301.1]	The aim is to explain the basic fundamentals of materials science and engineering.	3		1		2	3	1	1	1	
[1301.2]	Structure of crystalline solids, crystallography, lattice imperfections, and their effects on structure and related properties will be discussed**.**	3	1	1		2	1		1		1
[1301.3]	Students can able to learn materials acquire knowledge about failure phenomena, mechanical testing, interpretation of test results, concept of phase transformation, phase diagrams and its influence on properties of engineering materials will be Highlighted for improving research skills.	3	2		1	1	2	1		2	2
[1301.4]	This course will also combine traditional instruction in ceramic, metallurgy, polymer and fibre science and engineering with modern materials, including nano-, bio-, composite, smart materials, their stricture-property correlations, and applications.	3	1	1		1	1	1		1	2

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering
Department of Mechanical Engineering
Course Hand-out
Kinematics of Machines| ME 1302 | 4 Credits | 4 0 0 4

Session: July 18 – Dec 18 | Faculty: Dr.Ashish Sharma/Dr.Ashish Srivastava/B.Tech Semester III

A. Introduction: This course is offered by Dept. of Mechanical Engineering which focuses on mainly kinematics and mechanism. It deals with degree of freedom of mechanism and machines, in addition to this it also covers velocity and acceleration analysis. This course gives an overview of fundamental working of brakes, clutches and various gear box. This course is pre-requisite for dynamics of machines which deals with force analysis.

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

[**ME1302.1]** Understand the concepts of linkage and their relative motion.

[**ME1302.2]** Co-relate all the mechanism with real life machines.

[**ME1302.3]** Analyse the velocity and acceleration of different mechanism.

[**ME1302.4]** Create specific cam profile for specific follower movement.

[ME1302.5] Understand gear terminologies and various parameters related to gear motion such as path analysis.

[ME1302.6]Development of skills to analysis of forces and motion of transmission devices in automobile

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.

PROGRAM SPECIFIC OUTCOMES

[PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software
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Criteria	Description	Maximum Marks
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	Sessional Exam II (Open 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.	
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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.	

F. SYLLABUS

- Mechanism and Machine: Constrained motion, rigid and resistant bodies, link, kinematic pair and degrees of freedom. kinematic chain: Linkage mechanism and structure, mobility and range of movement - Kutzbach and Grubler's criterion, number synthesis, Grashof's criterion, Four bar chain and slider crank chain and its inversions.
- Introduction to synthesis of mechanism: Transmission angle, definition and determination of maximum and minimum transmission angle, two and three position synthesis of four bar mechanism and slider crank mechanism using graphical method.

- Displacement, velocity and acceleration analysis of plane mechanisms: Graphical and analytical methods, plane motion of a rigid body, Instantaneous Centre (IC) of velocity, velocity analysis using IC, velocity and acceleration diagrams, Corioli' s component of acceleration.
- Cam: Types, followers, definitions, displacement, derivatives, design of cam profiles, lay out and different types of contours of cams.
- Gear: Law of gearing, Spur Gears: definitions, cycloidal and involute teeth, rack and pinion, path of contact, arc of contact, minimum number of teeth , methods of avoiding interference, terminology of helical and bevel gears.
- Gear Trains: Simple, compound, reverted, epicyclic gear trains, problems to be solved by tabular method, torque calculations, automobile differential gear mechanism.
- Clutch and Brake: Uniform pressure and wear theory, different types of clutches, different types of brakes, band and block brake, types of dynamometer.

G. TEXT BOOKS

T1. S. S. Rattan, "Theory of machines" Tata McGraw Hill, 4th Edition, 2014.
T2. Amitabha Ghosh & Asok Kumar Mallik, "Theory of Mechanisms and Machines" East West Press, 3rd Edition, 2006

H. REFERENCE BOOKS

R1. Hamilton H. Mabie and Charles, "Mechanisms and dynamics of machinery" John Wiley and sons, 4 th Edition1987.
R2. J.E.Shigley and Jr.Uicker, "Theory of Machines and Mechanisms" Oxford University press, 4th Edition, 2011.
R3. R L Norton, "Kinematics and Dynamics of Machinery" Tata McGraw -Hill Education, 1st Edition in SI unit, 2009.

I. Lecture Plan:

Lec No	**Topics**	**Session Outcome**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing the Outcome**
1	Introduction to machines and mechanism	To acquaint and clear teachers expectations and understand student expectations	Lecture	NA	NA
2	Types of kinematics Pair, Types of links, Rigid bodies and Links	Knowledge of basics of kinematics linkage	Flipped Classroom	ME1302.1	In Class Quiz (Not Accounted)
3,4	Degree of freedom, Grublers' criterion	Able to understand mechanism input and specific output	Lecture	ME1302.1	In Class Quiz End Term Mid Term I
5,6	Four bar linkage, Slider crank mechanism	Practice of concept based numerical problems - I	Tutorial cum Lecture	ME1302.1	Class Quiz Mid Term I End Term
7,8	Problems on DoF	Practice of concept based numerical problems - II	Tutorial cum Lecture	ME130 2.1	Class Quiz Mid Term I End Term
9	Grashofs' law Transmission angle	Able to analyse various four bar inversions	Lecture	ME 1302.1	Class Quiz Mid Term I End Term
10	Inversions of mechanism	Able to analyse various inversions	Tutorial cum Lecture	ME 1302.1	Class Quiz Mid Term I End term Home Assignment
11,12	Synthesis of mechanism, Two and three position synthesis Problems on inversion	Analyse the motion of mechanism	Tutorial cum Lecture	1302.2	Class Quiz Mid Term I End Term
13,14	Velocity Analysis Introduction	Have basics of velocity analysis	Lecture	ME 1302.3	Class Quiz Mid Term I End Term
15,16	Instantaneous centre, Kennedy theorem Angular velocity theorem	Able to understand the velocity of different links and their motion	Lecture	ME 1302.3	Class Quiz Mid Term I End Term
17,18	Problems for velocity analysis	Analyse the total torque and its effect on crank shaft	Tutorial cum Lecture	ME 1302.3	Class Quiz Mid Term I End Term
19,20	Vector graphical method, Problems on velocity of mechanism	Practice of concept based numerical problems - III	Lecture	1302.3	Class Quiz Mid Term I End Term
21	Acceleration analysis Coriolis acceleration component	Get clear view about acceleration and coriolis component	Tutorial cum Lecture	1302.3	Class Quiz Mid Term I End Term

22,23	Problem on acceleration of mechanism	Able to calculate acceleration	Tutorial cum Lecture	1302.3	Class Quiz Mid Term I End Term
24	Types of cam & followers	Introducing Cams and follower	Lecture	1302.4	Class Quiz Mid Term II End Term
25,26	Derivatives, motions of the follower	Analyse the operation of cams and flower motion	Lecture	ME1302.4	Class Quiz Mid Term II End Term
27	Design cam profiles	Able to draw cam profile	Lecture	ME1302.4	Class Quiz Mid Term II End Term
28,29	problem on SHM, constant velocity cam profile	Practice of concept based numerical problems - IV	Tutorial cum Lecture	ME1302.4	Class Quiz Mid Term II End Term
30	problem on constant acceleration and cycloidal profile	Able to calculate different forces and speeds of different governor	Tutorial cum Lecture	ME1302.4	Class Quiz Mid Term II End Term
31,32	Inclined plane friction, Flat and collar friction	Analyse the friction	Lecture	1302.6, 1302.2	Class Quiz Mid Term II End Term
33	Friction clutch, Cone clutch	Introducing Clutch	Lecture	1302.6, 1302.2	Class Quiz Mid Term II End Term
34	Problems on clutch	Practice of concept based numerical problems - V	Tutorial cum Lecture	ME1302.6	Class Quiz Mid Term II End Term
35	Block or shoe brakes	Introducing brakes	Lecture	ME1302.6	Class Quiz Mid Term II End Term
36	Band and block brakes	Knowledge of different types of brakes	Tutorial cum Lecture	1302.6, 1302.2	Class Quiz Mid Term II End Term
37,38	Problems	Practice of concept based numerical problems - VI	Tutorial cum Lecture	ME1302.6	Class Quiz Mid Term II End Term
39,40	Types of gears	Introducing Gears	Lecture	ME1302.5	Class Quiz End Term
41	Gear terminology	Understanding on gear terminology	Lecture	ME1302.5	Class Quiz End Term
42,43	Law of gearing & gear tooth profile	Analyse the gear profile	Lecture	ME1302.5	Class Quiz End Term
44,45	Minimum number of teeth to avoid interference	Able to minimize the interference	Lecture	ME1302.5	Class Quiz End Term
46	Undercutting	Analyse the effects of interference and minimize it	Lecture	ME1302.5	Class Quiz End Term
47	Arc and path of contact	Able to calculate path of contact	Tutorial cum Lecture	ME1302.5	Class Quiz End Term

48	problems on gear terminology	Practice of concept based numerical problems - VII	Tutorial cum Lecture	1302.5	Class Quiz End Term
49	Gear Train	Introducing Gear trains	Lecture	1302.5	Class Quiz End Term
50,51	Epicycle gear train	Able to understand best suited gear train like epicyclic	Lecture	1302.5	Class Quiz End Term
52,53	Problems	Practice of concept based numerical problems - VIII	Tutorial cum Lecture	1302.5	Class Quiz End Term
54	Differential gear box in automobile vehicle	Have understanding of working of differential	Lecture	1302.6	Class Quiz End Term

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

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSPS O 1	S O 2	O 3
ME1302.1	Understand the concepts of linkage and their relative motion.	3	2				1	1					2			
ME1302.2	Co-relate all the mechanism with real life machines.	3	1	1			1						1			
ME1302.3	Analyse the velocity and acceleration of different mechanism.	3	2	1	1											
ME1302.4	Create specific cam profile for specific follower movement.	3	2	1	2									1		
ME1302.5	Understand gear terminologies and various parameters related to gear motion such as path analysis.	3	2	1									1			
ME1302.6	Development of **skills** to analysis of forces and motion of transmission devices in automobile	3	2	2									1	1		

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering
Department of Mechanical Engineering
Course Hand-out

Applied Thermodynamics| ME 1303 | 4 Credits | 3 1 0 4

Session: July 18 – Dec 18 | Faculty: Shashi Bhushan/Pooja Singh/ | Class: B. Tech. Sem III.

A. INTRODUCTION: This course is offered by Dept. of Mechanical Engineering, targeting students who wish to pursue research& development in industries or higher studies in field of Mechanical engineering. In this course we aimed to make the students familiar with the application of thermodynamics. Further to explain the Basic working and principle involved Refrigeration, Air conditioning, compressors, thermodynamics relations and to explain effect compressibility and introduction to shock waves.

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

[ME1303.1]. Apply different laws and basic concept of thermodynamics in daily life engineering applications.

[ME1303.2]. Analyse the properties of real gas and ideal gas mixtures.

[ME1303.3]. Comprehend the basic definitions and terminology of psychrometry and air conditioning.

[ME1303.4]. Design of reciprocating machines as well as Impact of compressible fluids flow.

[ME1303.5]. Judge and apply the basic thermodynamic principles for design, operation and behavior involved in the development, production, procurement for employability.

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 under- standing 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.

PROGRAM SPECIFIC OUTCOMES:

[PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software

[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels

[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional, quizzes and assignments	60 %
End Term Exam (Summative)	End semester examination	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

Thermodynamic Relations: Some mathematical theorems, Maxwell's equations, TdS equations, Difference in heat capacities, ratio of heat capacities, energy equation, Joule-Thomson effect. Clausius- Clapeyron equation, Evaluation of thermodynamic properties from an equation of state. Helmoltz and Gibbs functions; Maxwell's relations; Enthalpy, entropy, internal energy, and specific heat relations; Clausius-Clapeyron's equation; Applications to ideal and real gases. Joule-Thomson coefficient**. Ideal Gas Mixtures:** Dalton's law of additive pressures, Amagat's law of additive volumes, evaluation of properties. Analysis of various processes.**Pscychrometry :** Atmospheric air and Psychometric properties; Dry bulb temperature, wet bulb temperature, dew point temperature; partial pressures, specific and relative humidity and the relation between the two. Enthalpy and adiabatic saturation temperature. Construction and use of psychrometric chart. Analysis of various processes;

heating, cooling, dehumidifying and humidifying. Adiabatic mixing of stream of moist air. Summer and winter air-conditioning. **Reciprocating Compressors** Operation of a single stage reciprocating compressors. Work input through p-v diagram and steady state steady flow analysis. Effect of clearance and volumetric efficiency. Adiabatic, isothermal and mechanical efficiencies. Multi-stage compressor, saving in work, optimum intermediate pressure, inter-cooling, minimum work for compression. **Compressible Flows and Steam Nozzles** Compressible Flows: Velocity of pressure pulse in a fluid, stagnation properties, one dimensional steady isentropic flow, critical properties -choking in isentropic flow, normal shocks, adiabatic flow with friction and without friction, numerical problems. Steam nozzles: Flow of steam through nozzles, shape of nozzles, effect of friction, critical pressure ratio, supersaturated flow**.**

F. Text Books:

T1.P.K.Nag, *Basic and Applied Thermodynamics*, Tata McGraw Hills, 2006.
T2. Estop and McConkey, *Applied Thermodynamics for Engineering Technologies* , Longman 2002.

G. Reference Book

R1. T. D. Eastop, *Applied Thermodynamics,* Pearson Education(Singapore) Pte. Ltd.-Delhi
R2. William Z Black and James G Hartley, *Thermodynamics,* Pearson Education (2010).

G. Lecture Plan:

Lecture S.no.	Portions to be covered	Mode of delivery	Corresponding CO	Mode of assessing the outcome
1	Revision of Basic thermodynamics	Lecture	ME 1303.1	----------
2	Importance of thermodynamics relations, Maxwell equations,	Lecture, C& T	ME 1303.1	Class quiz
3	Tds equation , Derivation for 1st Tds	Lecture, C&T	ME 1303.1	Class Quiz
4	Derivation for 2nd and 3rd Tds equations	Lecture, C&T	ME 1303.1	Quiz, Sessional Exam
5	Heat capacities and relation between gas constant and heat capacity	Lecture, C&T	ME 1303.1	Class test
6	Joule-Thomson effect, different form of Joule-Thomson effect	Lecture, C&T	ME 1303.1	Class quiz
7	Clausius-Clapeyron equation, and its application for Evaluate different thermodynamic properties, Equation of state	Lecture, C&T	ME 1303.1	Class test, Sessional Exam
8	Helmoltz and Gibbs functions; Maxwell's relations; Enthalpy, entropy, internal energy, and specific heat relations	Lecture, C&T	ME 1303.1	Class quiz
9	Clausius-Clapeyron's equation and its Applications to ideal and real gases Joule-Thomson coefficient.	Lecture, C&T	ME 1303.1	Quiz
10	Joule-Thomson effect and coefficient, relation between Joule Thomson coefficient and thermodynamic properties.	Lecture, C&T	ME 1303.1	Class Quiz
11	Assignment on thermodynamic relations	Lecture, C&T	ME 1303.2	Class quiz
12	Other important derivations for thermodynamic properties	Lecture, C&T	ME 1303.2	Class quiz, Sessional Exam
13	Ideal Gas Mixtures: Dalton's law of additive pressures, Amagat's law of additive volumes	Lecture, C&T	ME 1303.2	Class quiz
14	Evaluation of important thermodynamic properties for gases. Analysis of various processes.	Lecture, C&T	ME 1303.2	Assignment
15	Assignment on ideal gas mixture	Flipped Classroom	ME 1303.2	Quiz
16	Introduction Pscychrometry : Atmospheric air, Psychometric properties; Dry bulb	Lecture, C&T	ME 1303.2	Class Quiz

	temperature, wet bulb temperature, dew point temperature, specific and relative humidity			
17	The relation among important psychometric properties	Lecture, C&T	ME 1303.2	Class test
18	Assignment on relation between different psychrometric properties	Lecture, C&T	ME 1303.2	Quiz
19	Adiabatic saturation temperature. Construction and use of psychro metric chart	Lecture, C&T	ME 1303.2	Quiz
20	Different phychrometric process and different method for theses process, theses process on psychrometric chart	Lecture, C&T	ME 1303.2	Class quiz
21	Assignment on psychrometric process	Flipped Classroom	ME 1303.3	Sessional exam
22	Class Test – 1	Activity	ME 1303.3	Quiz
23	Adiabatic mixing of stream of moist air	Lecture, C&T	ME 1303.3	Class quiz
24	Summer and winter air-conditioning	Lecture, C&T	ME 1303.3	Quiz
25	Assignment on air-conditioning	Flipped Classroom	ME 1303.3	Class Quiz
26	Numericals on psycrometry	Lecture, C&T	ME 1303.3	Quiz
27	Discussion of 1st mid-term question paper	Lecture, C&T	ME 1303.3	Sessional Exam
28	Calculation of psychrometric properties with psycrometric chart	Lecture, C&T	ME 1303.3	Sessional Exam
29	Calculation of psychrometric properties without psycrometric chart	Lecture, C&T	ME 1303.3	Quiz
30	Classification of compressors, types of compressors	Lecture, C&T	ME 1303.3	Class quiz
31	Reciprocating air compressors working and layout, work done by compressor	Lecture, C&T	ME 1303.3	Sessional Exam
32	Steady state and steady flow analysis of air compressor	Lecture, C&T	ME 1303.4	Assignment
33	Effect of clearance volume and volumetric efficiency of compressor	Lecture, C&T	ME 1303.4	Quiz
34	Adiabatic, isothermal and mechanical efficiency of compressor	Flipped Classroom	ME 1303.4	Class quiz
35	Assignment on compressor	Flipped Classroom	ME 1303.4	Quiz
36	Multi cylinder compressor and its working	Lecture, C&T	ME 1303.4	End term Exam

37	Working of double cylinder compressor on P-V diagram	Lecture, C&T	ME 1303.4	Quiz
38	Optimum intermediate pressure and work done in double cylinder compressor	Lecture, C&T	ME 1303.4	Class quiz
39	Intercooling and minimum work done for double cylinder compressor	Lecture, C&T	ME 1303.4	Quiz
40	Assignment on double cylinder compressor	Flipped Classroom	ME 1303.4	Class quiz
41	Compressible flow introduction, application and importance	Lecture, C&T	ME 1303.4	Class test, End term Exam
42	Velocity of pressure pulse in a fluid, speed of sound in single and double Phase	Lecture, C&T	ME 1303.4	Discussion
43	Isentropic flow, stagnation state for ideal gas model	Lecture, C&T	ME 1303.5	Class quiz
44	Isentropic converging- diverging flow in cross section, isentropic table	Lecture, C&T	ME 1303.5	Quiz
45	Assignment on isentropic flow and stagnation state	Flipped Classroom	ME 1303.5	End term Exam
46	Class Test – 2	Activity	ME 1303.5	Quiz
47	Discussion of 2nd mid-term question paper	Lecture, C&T	ME 1303.5	Class quiz
48	Introduction to Fanno flow and Rayleight flow	Lecture, C&T	ME 1303.5	Quiz
49	Flow through steam nozzle, types of steam nozzle,	Lecture, C&T	ME 1303.5	Class quiz
50	critical properties-choking in isentropic flow	Lecture, C&T	ME 1303.5	Class test, End term Exam
51	Super saturated flow, Wilson's line	Lecture, C&T	ME 1303.5	Discussion
52	Assignment on super saturated flow	Flipped Classroom	ME 1303.5	Class quiz

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

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
ME 1303.1	Apply different laws and basic concept of thermodynamics in daily life engineering applications	3	2				2						2			
ME 1303.2	Analyse the properties of real gas and ideal gas mixtures		3													1
ME 1303.3	Comprehend the basic definitions and terminology of psychrometry and air conditioning	2	2													
ME 1303.4	Design of reciprocating machines as well as Impact of compressible fluids Flow		3	2										3		
ME 1303.5	Judge and apply the basic thermodynamic principles for design, operation and behaviour involved in the development, production, Procurement for employability.			2		2								2		

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering
Department of Mechanical Engineering
Course Hand-out
Strength of Materials| ME 1304 | 3 Credits | 3 0 0 3

Session: July 18 – Dec 18 | Faculty: Prof Sasanka Sekhar Ghosh, Dr. Dharmesh Misra, Mr. Ravinder Jhorar | Class: B. Tech. Sem. III

A. INTRODUCTION: This course is offered by Dept. of Mechanical Engineering, targeting students to make them aware of the basic science of mechanics and to acquaint them with introduction of science of forces applied to structures. Strength of material is the science that deals with the relations between externally applied loads and internal effects on the bodies. The bodies are not supposed to be rigid and the deformation however small is of main interest. Briefly we can say that strength of materials is basically study of (i) the behavior of materials under different types of load and moment (ii) the action of forces and effects on structural and machine elements.

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

[ME 1304.1]. Understand the concepts of stress and strain at a point as well as the stress-strain relationships.
[ME 1304.2]. Compute shear force, bending moment, slope and deflection of a beam.
[ME 1304.3]. Determine the torsion in circular members.
[ME 1304.4]. Understand the concept of stability and buckling of column.
[ME 1304.5]. Calculate the stresses and strains associated with thin-wall spherical and cylindrical pressure vessels.
[ME 1304.6]. Determine and illustrate principal stresses, maximum shearing stress, and the stresses acting on a plane by FEM to improve design 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.

PROGRAM SPECIFIC OUTCOMES:

PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software
[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels
[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

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

Introduction: Rigid and Deformable bodies, Strength, Stiffness and Stability, Stresses, Tensile, Compressive and Shear, 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 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.

F. TEXT BOOK:

T1.Timoshenko S P and Young D H, "Elements of Strength of Materials", East West Press, New Delhi.
T2. Beer & Johnston, "Vector Mechanics for Engineers", Tata McGraw Hill, 2004.

G. REFERENCE BOOKS:

R1.E.P Popov, "Mechanics of Materials", S.I. Version, PHI, 1993
R2.S.S. Ratan, "Strength of Materials", McGraw Hill Education, Second Edition, 2011.
R3. F.L. Singer, "Egineering Mechanics", Harper & Row,1994.
R4.Bhavikatti & Rajasekharappa, "Engineering Mechanics", New Age International, 2006.

H. LECTURE PLAN:

Lecture S.no.	Portions to be covered	Mode of delivery	Corresponding CO	Mode of assessing the outcome
L1	Introduction and significance of the course: Solid Mechanics	Lecture	ME 1304.1	----------
L2	Properties of Materials: Strength, Stiffness and Stability, Stress and its type: Tensile, Compressive and Shear	Lecture, C& T	ME 1304.1	Class quiz/ Sessional Exam
L3	Strain, Hooke's Law, Stress-strain(σ-ϵ) curve	Lecture, C&T	ME 1304.1	Class Quiz/ Sessional Exam
L4	Deformation of simple and compound bars under axial load	Lecture, C&T	ME 1304.1	Quiz, Sessional Exam
L5	Numerical practices on deformation under axial load	Activity	ME 1304.1	Class test/ Sessional Exam
L6	Thermal Stress and strain calculation for composite beam	Lecture, C&T	ME 1304.1	Class quiz/ Sessional Exam
L7	Numerical practices on thermal stress-strain	Lecture, C&T, Activity	ME 1304.1	Class test, Sessional Exam
T1	Elastic constants, Strain energy and unit strain energy	Lecture, C&T	ME 1304.1	Class quiz/ Sessional Exam
L8	Numerical practices	Activity	ME 1304.1	Quiz/ Sessional Exam
L9	Loads and Stresses: Types of beams, supports and loads, Shear force diagram(SFD) and Bending Moment diagram(BMD)	Lecture, C&T	ME 1304.2	Class Quiz/ Sessional Exam
L10	Cantilever Beam and related Numerical Problems	Lecture, C&T	ME 1304.2	Class quiz/ Sessional Exam
L11	Simply Supported Beam and related Numerical Problems	Flipped Classroom	ME 1304.2	Class quiz, Sessional Exam
L12	Overhanging Beam and related Numerical Problems	Flipped Classroom	ME 1304.2	Class quiz / Sessional Exam
L13	SFD and BMD Numerical Problems: Assignment-1	Discussion	ME 1304.2	Assignment

L14	Theory of Simple bending Stress, Stress variation along the length and in the beam section	Lecture, C&T	ME 1304.2	Quiz/ Sessional Exam
L15	Numerical Problems on pure bending stress	Flipped Classroom	ME 1304.2	Class Quiz/ Sessional Exam
L16	Effect of shape of beam section on stress induced, Shear stresses in beams, Shear flow	Lecture, C&T	ME 1304.2	Class test
L17	Numerical Problems on shear stress in beams	Flipped Classroom	ME 1304.2	Quiz/ Sessional Exam
L18	Torsion of circular bars, Shear stress distribution	Lecture, C&T	ME 1304.3	Quiz/ Sessional Exam
L19	Numerical Practices	Lecture, C&T	ME 1304.3	Class quiz/ Sessional Exam
L20	Bars of solid and hollow circular section, Stepped shaft	Flipped Classroom	ME 1304.3	Sessional exam
L21	Numerical Practices	Flipped Classroom	ME 1304.3	Quiz/ Sessional Exam
L22	Twist and torsion stiffness, Fixed and simply supported beams,	Lecture, C&T	ME 1304.3	Class quiz/ Sessional Exam
L23	Numerical Practices	Flipped Classroom	ME 1304.3	Quiz/ Sessional Exam
L24	Elastic curve of neutral axis of the beam under normal loads	Lecture, C&T	ME 1304.2	Class Quiz/ Sessional Exam
L25	Numerical Practices	Flipped Classroom	ME 1304.2	Quiz/ Sessional Exam
L26	Beam deflection and its slope, Macaulay's Method	Lecture, C&T	ME 1304.2	Sessional Exam
L27	Numerical Practices on various types of beams	Flipped Classroom	ME 1304.2	Sessional Exam
L28	Columns , End conditions, Equivalent length of a column	Lecture, C&T	ME 1304.4	Quiz/ Sessional Exam
L29	Numerical Practices	Lecture, C&T	ME 1304.4	Class quiz/ Sessional Exam
L30	Euler equation, Slenderness ratio and numerical practices	Activity	ME 1304.4	Sessional Exam
L31	Rankine formulae and numerical Practices: Assignment-2	Discussion	ME 1304.4	Assignment
L32	Introduction to analysis of stresses in two dimensions	Lecture, C&T	ME 1304.6	Quiz/ Sessional Exam
L33	Biaxial state of stresses	Flipped Classroom	ME 1304.6	Class quiz/ Sessional Exam
L34	Numerical practices	Activity	ME 1304.6	Quiz/ Sessional Exam
L35	Thick and thin cylindrical shells	Lecture, C&T	ME 1304.5	End term Exam
L36	Numerical Practices	Flipped Classroom	ME 1304.5	Quiz/ End term Exam
L37	Deformations, Biaxial stresses at a point	Lecture, C&T	ME 1304.6	Class quiz/ End term Exam
L38	Numerical Practices	Flipped Classroom	ME 1304.6	Quiz/ End term Exam
L39	Stresses on inclined plane	Lecture, C&T	ME 1304.6	Class quiz/ End term Exam
L40	Principal planes and stresses	Lecture, C&T	ME 1304.6	Class test, End term Exam
L41	Mohr's circle for biaxial stresses: Assignment-3	Lecture, Activity	ME 1304.6	Discussion/ End term Exam
L42	Critical Problem on biaxial stresses	Flipped Classroom	ME 1304.6	End term Exam

I. COURSE ARTICULATION MATRIX (Mapping of COs with POs):

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WIT I PROGRAM SPECIFIC OUTCOME ;		
		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 1304.1	Understand the concepts of stress and strain at a point as well as the stress-strain relationships.	3	3													
ME 1304.2	Compute shear force, bending moment, slope and deflection of a beam.	3	3	1												
ME 1304.3	Determine the torsion in circular members.	3	3	1												
ME 1304.4	Understand the concept of stability and buckling of column.	3	3	1												
ME 1304.5	Calculate the stresses and strains associated with thin-wall spherical and cylindrical pressure vessels.	3	3	2												
ME 1304.6	Determine and illustrate principal stresses, maximum shearing stress, and the stresses acting on a plane by FEM to improve design skills.	3	3	2												

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

DEPARTMENT OF MECHANICAL ENGINEERING

Course Hand-out
Engineering Mathematics IV | MA 1410 | 3 Credits ession:
January-19-May-19 | Faculty: Dr. V.S. Chauhan; B.Tech Semester IV

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 of Numerical analysis, Solution of algebraic and transcendental equations, Solution of differential equations, partial differential equations by numerical methods, Basic knowledge Statistics, Distributions and Tensors. Students are expected to have background knowledge on finding roots of algebraic equations, differential equations, probability, two and three dimensional geometry for a better learning.

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

[MA1410.1] Analysis the problems of engineering by using Numerical analysis.

[MA1410.2]. Solve for the zero of a non-linear algebraic function using bisection and regula- falsi methods, as well as Newton-Raphson and secant iteration methods.

[MA1410.3]. Solve the ordinary and partial differential equations by using numerical methods.

[MA1410.4] Draw normal distribution curve and will be able to compare the results to improve analytical skills.

[MA1410.5] To understand and calculate figures of more than three dimensions.

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

PROGRAM SPECIFIC OUTCOME

[PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software
[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels
[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

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

Tensor: Introduction to tensors, Cartesian tensors, Rank of tensor, First, second and higher order tensors, Algebraic operation on tensors, contraction of tensors, Contravariant and covariant vectors and tensors, Theorem based on tensors.**Solution of Non Linear Equations:** Bisection, Newton-Raphson, Regula Falsi, Secant Methods.

System of Simultaneous Linear Equations: Gauss elimination method, Gauss-Jacobi, Gauss-Seidel.

Solution of Initial Value Problems: Taylor's series method, Euler method, modified Euler method, Runge-Kutta 4th order method.

Finite Difference Methods: Solution of Laplace and Poisson equations by standard five point formula, Solution of heat equations by Crank-Nicolson method, Solution of Wave Equations.

Statistics: Correlation, Regression, Random variables, Probability distributions – Binomial, Poisson, Normal.

Text Books:

T1.B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, Delhi, 2006.

T2.Srimanta Pal, Subhdh C. Bhunia, "Engineering Mathematics", Oxford University Press, 2015.

T3.H. K. Das, "Advanced Engineering Mathematics" S. Chand, 2015.

References:

R1.Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India Eastern, 2006.

R2.B. V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill Education Private Limited, New Delhi 2007.

F. Lecture Plan:

Description of the syllabus	No of Hours Allotted	Cumulated lectures
Introduction	1	1
Solution of Non Linear Equations: Bisection	1	2
Secant Methods	1	3
TUTORIAL CLASS – 1	**1**	**4**
Regula Falsi Method	1	5
Generalized Newton Raphson Method, Newton Raphson Method for a system of non-linear equations	1	6
Solution of system simultaneous Linear Equation- Gauss elimination method	1	7
TUTORIAL CLASS – II	**1**	**8**
ASSIGNMENT I		
Gauss Jacobi	1	9
Gauss Seidel	1	10
Solution of Initial Value Problems- Taylor's series method	1	11
TUTORIAL CLASS – III	**1**	**12**
Euler method	1	13
Modified Euler method	1	14
Runge-Kutta 4th order method	1	15
TUTORIAL CLASS – IV	**1**	**16**
ASSIGNMENT II		
Finite Difference Methods: Solution of Laplace equations by five point formula	1	17
Solution of Poisson equations by five point formula	1	18
Heat equations	1	19
TUTORIAL CLASS – V	**1**	**20**
Wave equations	1	21
Statistics: Probability, Random Variables	2	22
TUTORIAL CLASS – VI	**1**	**23**
ASSIGNMENT III		
Probability Distributions: Binomial Distribution	1	24
Poisson Distribution	1	25
Normal Distribution	1	26
TUTORIAL CLASS – VII	**1**	**27**
Correlation	1	28
Regression	1	29
least square principle of curve fitting	1	30
TUTORIAL CLASS – VIII	**1**	**31**
ASSIGNMENT IV		
Tensor: Introduction to tensors	1	32
Cartesian tensors, Rank of tensor	1	33
First, second and higher order tensors	1	34
TUTORIAL CLASS – IX	**1**	**35**
Algebraic operation on tensors	1	36
Contraction of tensors	1	37
Theorem based on tensors	2	39
TUTORIAL CLASS – X	**1**	**40**
ASSIGNMENT V		

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
MA 1410.1	Analysis the problems of engineering by using Numerical analysis.	2									2			1		
MA 1410.2	Solve for the zero of a non-linear algebraic function using bisection and regula-falsi methods, as well as Newton-Raphson and secant iteration methods.	2			1										2	
MA 1410.3	Solve the ordinary and partial differential equations by using numerical methods	2				1										1
MA 1410.4	Draw normal distribution curve and will be able to compare the results to improve analytical skills**.**	2									1					
MA1 410.5	Understand and calculate figures of more than three dimensions	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 Mechanical Engineering
Course Hand-out
Fluid Mechanics and Hydraulic Machines| ME1401 | 4 Credits |
Jan19 – May 19 | Faculty: Dr. Ravi k Sharma/ Dr Mayank Modak/ Ravinder Jhorar | Class: B.Tech Sem. IV

A. Introduction: This course is offered by Dept. of Mechanical Engineering as a core subject, targeting students who wish to pursue research& development in industries or higher studies in field of Fluid Mechanics. Offers in depth knowledge of working of hydraulic machines. The course covers the behaviour of fluid at rest and in motion. Students are expected to have background knowledge of Engineering Mechanics and Basic Physics.

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

[ME1401.1] Describe the properties and classification of fluid and depict the effect of these properties on fluid in motion and at rest.
[ME1401.2] Establish understanding about fluid pressure and flow rate measuring devices.
[ME1401.3] Analyse the stability of floating and submerged bodies and distinguish between various types of flows. [1401.4] Modify different operating parameters to enhance the performance of hydraulic machines.
[ME1401.5] Recognize different applications of fluid mechanics and fluid flow through different cross- sections.
[ME1401.6] Fabricate devices which exhibit the principles of fluid mechanics and evaluate their performance for better employability.

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

PROGRAM SPECIFIC OUTCOMES:

[PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software.

[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels.

[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	15
	Sessional Exam II (Closed Book)	15
	Class 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, 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

Properties of Fluids: Introduction, Various properties, Newtonian and Non-Newtonian Fluids.
Fluid Statics: Pressure and its measurement: Pressure gauge, Manometers, Pascal's law, Hydrostatic law: Forces on plane and curved surfaces, Centre of pressure; Buoyancy, equilibrium of submerged and floating bodies, metacentric height.
Fluid Kinematics: Lagrangian and Eulerian description of fluid flow, Types of Fluid flow, Stream line, path line and streak lines, Continuity equation, Fluids subjected to Velocity and acceleration, vorticity, circulation, Stream function, Velocity Potential function, Cauchy Riemann equation.
Fluid Dynamics: Euler's and Bernoulli's equation, Bernoulli's theorem, Applications of Bernoulli's equation, Vortex Motion: Free and Forced.
Viscous flow: Reynold's Number, Darcy Weisback equation, Laminar flow: circular pipe (Hagen Poiseuille's equation), Parallel Plates; Flow: Pipe flow, Friction factor, Minor and major losses in pipe, Boundary layer concept, Boundary layer separation.
Dimensional Analysis: Basic and derived quantities, Similitude and dimensional analysis, Buckingham π – theorem, Non-dimensional parameters and its significance.
Hydraulic Machines
Rotating Elements: Classification and efficiencies of turbines, performance curve. Reciprocating Pump: - Working principle, discharge, work done, efficiency, slip.
Centrifugal Pump: Working principle, indicator diagram, components, Efficiency, Pump characteristics, multistage centrifugal pump.

F Text Books:

T1.Frank M. White, "Fluid Mechanics" Tata McGraw Hills Pub., Seventh Edition, 2011.

T2. P. N. Modi and Seth, *Fluid Mechanics, Standard Book House Pub., 2002.*

G References:

R1.Yunus A. Cengel, John M. Cimbala, Fluid Mechanics, Third Edition, 2014.

R2.A. K. Jain, "Fluid Mechanics Including Hydraulic Machines" Khanna Publication, 12th Edition.

R3.R. K. Bansal, "Fluid Mechanics and Hydraulic Machines", Laxmi Publications, Ninth Edition, 2015.

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	Properties of Fluids, Types of fluids and Newton's law of viscosity	Understand working knowledge of basic properties of fluid and consequences of frictional effects it causes in fluid flow	Lecture	1401.1	In Class Quiz (Not Accounted)
3	Numerical based on Newton's law of viscosity	Analytically find out the shear stress/ coefficient of viscosity/ rate of change of velocity with distance	Lecture	1401.2	In Class Quiz End Term
4	Vapour pressure, Surface Tension and Capillarity	Recall the concept of surface tension, capillarity and their effects	Lecture	1401.2	Home Assignment End Term
5	Numerical on Surface Tension and Capillarity Vapour pressure, Surface Tension and Capillarity	Calculate the capillary rise and fall in tubes due to surface tension effects	Lecture	1401.3	In Class Quiz End Term
6	Fluid Statics- Introduction	Recall the concept of fluid pressure and units of pressure	Lecture	1401.3	Class Quiz Mid Term I End Term
7	Fluid flow measurements- Manometers	Understand the working of a manometer	Lecture	1401.3	Class Quiz Mid Term I End term
8	Types of Manometers and Numerical on Manometers	Calculate the pressure using various kinds of manometer	Lecture	1401.3	Home Assignment Class Quiz Mid Term I End Term
9	Hydrostatic forces on plane surfaces	Recall forces and moments exerted by fluid at rest on plane surface	Lecture	1401.3	Class Quiz Mid Term I End Term
10	Hydrostatic forces on inclined and curved surfaces	Recall forces and moments exerted by fluid at rest on inclined and curved surfaces	Lecture	1401.3	Class Quiz Mid Term I End Term
11	Numerical on Hydrostatic forces on various surfaces	Calculate forces and moments exerted by fluid at rest on plane, inclined and curved surfaces	Lecture	1401.4	Class Quiz End Term
12	Buoyancy and Floatation	Analyse the stability of floating and submerged bodies	Lecture	1401.3	Class Quiz Mid Term II End Term
13	Metacentric Height and derivation of its mathematical expression	Analyse the stability of floating and submerged bodies	Lecture	1401.3	Class Quiz Mid Term II End Term
14	Conditions of equilibrium for	Analyse the stability of	Lecture	1401.2	Class Quiz

	a floating and submerged body	floating and submerged bodies			Mid Term II End Term
15	Numerical on Buoyancy and Metacentric Height	Evaluate the buoyant force and metacentric height	Lecture	1401.3	Class Quiz Mid Term II End Term
16	Fluid Kinematics- Introduction and Types of flow	Describe the motion of fluid without considering the forces causing the motion, Distinguish between different flows	Lecture	1401.3	Class Quiz End Term
17	Continuity Equation	Assumptions while deriving the continuity equation	Lecture	1401.3	Class Quiz End Term
18	Numerical based on continuity equation	Calculate the dimension(s) of the pipeline	Lecture	1401.2	Class Quiz End Term
19	Eulerian and Lagrangian approach with related numerical	Understand the role of material derivative in transforming between Lagrangian and Eulerian descriptions	Lecture	1401.2	Class Quiz End Term
20	Potential function and Stream Function	Describe the concept of potential and stream function	Lecture	1401.2	Class Quiz End Term
21	Flow Net, Equipotential lines, Relation between Potential function and Stream Function	Mathematically analyse potential and stream function	Lecture	1401.2	Class Quiz End term
22	Numerical on Potential function and Stream Function	Mathematically analyse potential and stream function	Lecture	1401.2	Class Quiz
23	Fluid Dynamics- Introduction	Apply the conservation of mass equation to balance the incoming and outgoing flow rates in a flow system	Lecture	1401.2	Class Quiz Mid Term II End Term
24	Euler's Equation and its derivation	Apply the conservation of mass equation to balance the incoming and outgoing flow rates in a flow system	Lecture	1401.2	Class Quiz Mid Term II End Term
25	Bernoulli's equation from Euler equation	Understand the use and limitations of Bernoulli's equation	Lecture	1401.2	Class Quiz Mid Term II End Term
26	Bernoulli's equation for the flow of incompressible fluid	Understand the use and limitations of Bernoulli's equation	Lecture	1401.2	Class Quiz End Term
27	Bernoulli's equation for a real fluid	Understand the use and limitations of Bernoulli's equation	Lecture	1401.2	Class Quiz End Term
28	Numerical based on Bernoulli's equation	Work with the energy equation expressed in terms of heads and use it to determine power output	Lecture	1401.2	Class Quiz End Term
29	Practical Applications of Bernoulli's equation	Describe various applications of the	Lecture	1401.2	Class Quiz End Term

		equation			
30	Venturimeter and derivation of rate of flow equation	Understand the working principle of the device and apply energy balance to find flow rate	Lecture	1401.2	Class Quiz End Term
31	Numerical on Venturimeter	Determining unknown quantities in the equation	Lecture	1401.3	Class Quiz End Term
32	Orifice meter and derivation of rate of flow equation	Understand the working principle of the device and apply energy balance to find flow rate	Lecture	1401.3	NA
33	Numerical on Orificemeter	Determining unknown quantities in the equation	Lecture	1401.3	End Term Theory
34	Pitot tube and related numerical	Understand the working principle of the device and its application	Lecture	1401.3	Class Quiz End Term
35	V-notch and Rectangular notch	Describe fluid flow through different cross-sections	Lecture	1401.3	Class Quiz End Term
36	Dimensional Analysis-Introduction	Dimensionally examine the various fluid parameters and equations	Lecture	1401.3	Class Quiz End Term
37	Method of Dimensional analysis and Similitude	Dimensionally examine the various fluid parameters and equations	Lecture	1401.3	Class Quiz End Term
38	Buckingham Pi-theorem	Dimensionally examine the various fluid parameters and equations	Lecture	1401.4	Class Quiz End Term
39	Dimensionless numbers and their significance	Dimensionally examine the various fluid parameters and equations	Lecture	1401.3	NA
40	Laminar flow through circular pipe (Hagen Poiseuille's equation)	Derivation of final equation	Lecture	1401.2	Class Quiz End Term
41	Laminar flow between fixed parallel plates		Lecture	1401.1	Class Quiz Mid Term I End Term
42	Numericals on viscous fluid flow		Lecture	1401.2	Class Quiz Mid Term I End term
43	Flow Through Pipes- Darcy Weisbach equation	Recall fluid flow inside a pipe and the associated losses	Lecture	1401.3	Home Assignment Class Quiz Mid Term II End Term
44	Chezy's formula and numericals	Recall fluid flow inside a pipe and the associated losses	Lecture	1401.4	Class Quiz Mid Term II End Term
45	Loss of Head and flow through pipes in series	Recall fluid flow inside a pipe and the associated	Lecture	1401.3	Class Quiz Mid Term I

	parallel and branched	losses			End Term
46	Power transmission through pipes condition of maximum efficiency	Determination of power transmitted through fluid	Lecture	1401.4	Class Quiz End Term
47	Numericals on flow through pipes	Determination of power transmitted through fluid	Lecture	1401.4	Class Quiz Mid Term II End Term
48	Boundary layer concept-Laminar and Turbulent	Examine effect of interaction of fluid with solid surface and its consequences	Lecture	1401.4	Class Quiz Mid Term II End Term
49	Boundary layer separation	Examine effect of interaction of fluid with solid surface and its consequences	Lecture	1401.5	Class Quiz Mid Term II End Term
50	Boundary layer thickness, Momentum thickness, Energy thickness and based on numericals	Examine effect of interaction of fluid with solid surface and its consequences	Lecture	1401.5	Class Quiz Mid Term II End Term
51	Hydraulic Machines-Introduction	Recognize different hydraulic machines	Lecture	1401.5	Class Quiz End Term
52	Turbines-Classification, Efficiency and Performance curve	Performance analysis of turbines	Lecture	1401.5	Class Quiz End Term
53	Working principle, work done and efficiency of a Reciprocating pump	Describe Operating parameters	Lecture	1401.5	Class Quiz End Term
54	Working principle, work done and efficiency of a Centrifugal pump	Describe Operating parameters	Lecture	1401.5	Class Quiz End Term
55	Pump characteristics, Multistage centrifugal pump	Performance analysis of pumps	Lecture	1401.5	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
ME 1401.1	Describe the properties and classification of fluid and depict the effect of these properties on fluid in motion and at rest.	3							1							
ME 1401.2	Establish understanding about fluid pressure and flow rate measuring devices.		2	2								2				
1401.3	Analyse the stability of floating and submerged bodies and distinguish between various types of flows.				2	2										
1401.4	Modify different operating parameters to enhance the performance of hydraulic machines.						2		2	3						
1401.5	Recognize different applications of fluid mechanics and fluid flow through different cross- sections.			1						1	1					
1401.6	Fabricate devices which exhibit the principles of fluid mechanics and evaluate their performance for better employability.	3	2	2	2					2			1			

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering
Department of Mechanical Engineering
Course Hand-out
Dynamics of Machines| ME 1402 | 3 Credits | 3 0 0 3
Session: Jan19 – May 19 | Faculty: Prof. N N Sharma/Dr.Ashish Sharma/Mr.Arpit Khandelwal /B.Tech. IV Semester

A. Introduction: This course is offered by Dept. of Mechanical Engineering which focuses on mainly static and dynamic forces. It deals with dynamic analysis of four bar linkage, turning moment of crank shaft, analysis of flywheel, balancing of various engines, analysis of governors and gyroscopic effects. This course gives an overview of fundamental working of brakes, clutches and various gear box. This course is pre-requisite for understanding in vibrations of machines.

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

[ME1402.1] Identify the static and dynamics forces in different kinematic mechanism.
[ME1402.2] Estimate the forces and their effects on four bar mechanism (IC engines).
[ME1402.3] Construct the turning moment diagram of crank shaft for different cycles and manipulate the diagram with the help of flywheel.
[ME1402.4] Understanding the operations of different types of governors and their applications.
[ME1402.5] Analyse the gyroscopic effects and applications of gyroscope.
[ME1402.6] Develop employability skills for balancing of mechanical 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 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.

PROGRAM SPECIFIC OUTCOMES:

[PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software.

[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels.

[PSO.3]. Synthesis and Manufacturing: Synthesize advance materials for mechanical engineering applications.

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Open Book)	15
	Sessional Exam II (Open 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

- Static forces in Machines: Conditions of static equilibrium of a member under action of two forces, three forces, four forces and forces and a couple, Analysis of slider crank mechanism and four bar mechanism, example of quick return mechanism, Virtual work .Dynamic force analysis: Inertia forces, D Alembert's Principle, Inertia forces of connecting rod, inertia forces in slider crank mechanism, four bar mechanism, dynamically equivalent system, forces in engines, turning moment diagram of single cylinder engines, multi cylinder engines, mass and size of flywheel.Balancing of rotating masses in machinery, Balancing in same plane, balancing in different planes, balancing of reciprocating masses, Primary balancing and Secondary balancing of multi cylinder engines, inline engines, V- engines, and radial engines using direct and revers cranks concept.Governors, Centrifugal governors such as Porter, Proell, Hartnell, and Wilson Hartnell. Characteristics of governors, stability, Sensitiveness, isochronism, hunting, controlling force, effort and power of governors.Gyroscope: Principle of Gyroscopic couple, Effect of gyroscopic couple and centrifugal force on vehicle taking a turn, Stabilization of sea vessels, Condition for stability of a four wheeler and two wheelers.

F. TEXT BOOKS

T1. S. S. Rattan, "Theory of machines" Tata McGraw Hill, 4th Edition, 2014.
T2. Amitabha Ghosh & Asok Kumar Mallik, "Theory of Mechanisms and Machines" East West Press, 3rd Edition, 2006

G. REFERENCE BOOKS

R1. Hamilton H. Mabie and Charles, "Mechanisms and dynamics of machinery" John Wiley and sons, 4th Edition1987.
R2. J.E.Shigley and Jr.Uicker, "Theory of Machines and Mechanisms" Oxford University press, 4th Edition, 2011.
R3. R L Norton, "Kinematics and Dynamics of Machinery" Tata McGraw-Hill Education, 1st Edition in SI unit, 2009.

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 dynamics and basic concepts of kinematics	Recall kinematics of various mechanism	Flipped Classroom	1402.1	In Class Quiz (Not Accounted)
3	Two, three and four force member	Study equilibrium of forces on mechanism	Lecture	1402.1	In Class Quiz End Term
4,5	Problems on static equilibrium	Practice of concept based numerical problems - I	Lecture	1402.1	Class Quiz Mid Term I End Term
6	Problems on static equilibrium	Practice of concept based numerical problems - II	Lecture	1402.1	Class Quiz Mid Term I End Term
7	D'Alembert's Principle and introduction to dynamic force analysis	Able to analyse various dynamic forces in mechanism	Lecture	1402.1	Class Quiz Mid Term I End Term
8-10	Dynamic analysis of slider crank mechanism Angular velocity and acceleration of connecting rod Force analysis of Engine	Able to calculate different forces on IC engine	Tutorial cum Lecture	1402.2	Class Quiz Mid Term I End term Home Assignment
11,12	Problems on Engine force	Analyse the inertia and gas forces.	Tutorial cum Lecture	1402.2	Class Quiz Mid Term I End Term Class Quiz End Term
13,14	Dynamically equivalent system	Analyse the connecting rod inertia.	Lecture	1402.2	Class Quiz Mid Term II End Term
15	Correction Torque	Able to understand the effect of inertia of CR on moment of crank shaft	Lecture	1402.2	Class Quiz Mid Term II End Term
16,17	Problems on correction torque	Analyse the total torque and its effect on crank shaft	Lecture	1402.2	Class Quiz Mid Term II End Term Class Quiz Mid Term II End Term
18	Turning moment diagram	Understanding of turning moment diagram	Lecture	1402.3	Class Quiz End Term
19	Flywheel	Requirement of Flywheel	Flipped Class	1402.3	Class Quiz End Term
20,21	Problems on flywheel and TM Diagram	Able to calculate required inertia of flywheel for an engine	Tutorial cum Lecture	1402.3	Class Quiz End Term Class Quiz End Term
22	Introduction to governor	Introducing Governors	Lecture	1402.4	Class Quiz End Term

23	Porter Governor and proell governor	Analyse the operation of governor	Flipped Class	1402.4	Class Quiz End term
24	Spring loaded governors	Analyse the operation of governor	Flipped Class	1402.4	Class Quiz Mid Term II End Term
25	Spring loaded governors, Pickering Governor	Analyse the operation of governor	Flipped Class	1402.4	Class Quiz Mid Term II End Term
26,27	Problems on governors	Able to calculate different forces and speeds of different governor	Tutorial cum Lecture	1402.4	Class Quiz Mid Term II End Term
28,29	Sensitivity, Hunting, Isochronism and Stability and controlling force	Analyse and control the operation of governor	Lecture	1402.4	Class Quiz End Term
30	Gyroscope couple	Introducing Gyroscopic effect	Lecture	1402.5	Class Quiz End Term
31	Gyroscopic Effect on airplane and ship	Able to find the gyroscopic moment	Lecture	1402.5	Class Quiz End Term
32	Gyroscopic effect on an automobile	Analyse the stability of vehicle	Lecture	1402.5	Class Quiz End Term
33	Problems on above topic	Able to calculate different forces and reactions on vehicles	Tutorial cum Lecture	1402.5	Class Quiz End Term
34	Static balancing	Introduction to Balancing	Lecture	1402.6	Class Quiz End Term
35	Balancing of several masses on different planes	Analyse different procedure of balancing	Lecture	1402.6	Class Quiz End Term
36,37	Problems on balancing different planes	Able to calculate the balancing mass	Lecture	1402.6	Class Quiz End Term
37,38	Balancing of reciprocating engine	Analyse the unbalance force and couple	Lecture	1402.6	Class Quiz End Term
39	Partial balancing	Able to minimize the unbalance force	Lecture	1402.6	Class Quiz End Term
40,41	Multi-cylinder and V engine balancing	Able to balance the multi cylinder engines	Lecture	1402.6	Class Quiz End Term
42	Problems	Able to calculate unbalance forces and balance them	Tutorial cum Lecture	1402.6	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
ME1402.1	Identify the static and dynamics forces in different mechanism.	3	1										1			
ME1402.2	Estimate the forces and their effects on four bar mechanism (IC engines).	3	2	2		2							1	2		
ME1402.3	Construct the turning moment diagram of crank shaft for different cycles and manipulate the diagram with the help of flywheel.	3	2	2		1		1						1		
ME1402.4	Understanding the operations of different types of governors and their applications.	3	1	1		1		1						1		
ME1402.5	Analyse the gyroscopic effects and applications of gyroscope.	3	2	2		1		2						1		
ME1402.6	Develop employability skills for balancing of mechanical systems	3	2	3		2										

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering
Department of Mechanical Engineering
Course Hand-out
Production Technology I | ME 1403 | 4 Credits | 4 0 0 4
Session: Jan 2019 – May 2019 | Faculty: Dr A K Sharma/ Dr Ashish Goyal/ Dr Mithilesh Kumar| Class: B. Tech. Sem..IV

A. Introduction: This course is offered by Dept. of Mechanical Engineering, The course covers various methods and types of castings, welding processes, sheet metal forming and plastics. In a production shop, a successful engineer must have a thorough understanding of the subject if he/she has to select and implement the right processes. To impart knowledge on selection of suitable manufacturing process for the typical component. The selection of the important process parameter is extremely important to achieve the success in manufacturing. The knowledge of correct procedure, machine and parameter leads to the saving of material, rework and labour.

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

[ME1403.1]. Know the different manufacturing processes.
[ME1403.2]. Recognize different casting processes for specific product.
[ME1403.3]. Explain forming processes (forging, rolling and drawing).
[ME1403.4]. Describe joining processes and their applications for skills development.
[ME1403.5]. Explain the concepts of processing of plastic.

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 under- standing 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.

PROGRAM SPECIFIC OUTCOMES:

[PSO.1]. Modelling & Analysis: Model and Analyse mechanical engineering components using advanced software
[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels
[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

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

Casting: Introduction to casting, Patterns, types, materials, Allowances, Moulding sand composition, types of mould, Sand Testing Machine, Core types, Core making sands, Chills & Chaplets, Forces acting on Moulding flasks, Introduction to Crucible Melting & Cupola operation, Principles and design of Gating system, Gating Ratio, Riser types & Design, Concept of Solidification of casting, Introduction to Sand Casting, Special Casting Process Shell Mould Casting, Investment Casting, Die casting, Centrifugal Casting, CO2 Moulding, Applications-Advantages-Disadvantages of above processes, Defects in casting, causes & remedies. Metal Joining: Principles of welding, soldering, brazing. Types of welds and welded joints, Arc Welding its types Working, power sources, and electrodes and their coatings, weld bead geometry, V-I characteristic curves of power source, Simple Problems of V-I characteristic, Shielded Metal Arc Welding, Submerged Arc Welding, Gas Tungsten Arc Welding, Gas Metal Arc Welding, Gas Welding and Gas Cutting, Applications-Advantages- Disadvantages of above processes, Resistance Welding, Seam Welding, Projection Welding, Spot Welding, Heat Affected Zone in Welding, Minimization of HAZ, Special Welding Process – Friction Welding, Thermit Welding. Defects in Welding, causes & remedies. Metal Forming: Introduction to Metal Forming, Nature of plastic deformation, Hot and cold working, Strain hardening, Recrystallization and grain growth. Rolling: Principle, Types of rolling mills, Roll passes, Forces in rolling and power requirements. Extrusion: Basic extrusion process - Types. Forging: Principles of forging, Tools and dies, Types: Smith forging, Drop *Forging*, Forging hammers, Rotary forging, Forging defects, causes and remedies, Wire Drawing. Sheet Metal Forming: Spring back effect, Stamping, Blanking, Bending, Drawing, Piercing, Coining, Embossing, Stretch forming. Processing of Plastics: Types of Plastics, Properties and applications, Processing Methods & Equipment (Blow & Injection Moulding)

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. R.K. Jain, *Production Technology: Manufacturing Processes, Technology and Automation*", Khanna Publishers, 17th Edition, 2011.

R3. P.N. Rao, *Manufacturing Technology Volume-1*, Tata McGraw-Hill Education, 4th Edition, 2013.

H. LECTURE PLAN

Lecture	Topic	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
L1	Introduction and Course Hand-out briefing	To acquaint and clear teachers expectations and understand student expectations	Lecture	NA	NA
L2	Introduction & classification of manufacturing processes	Student will able to differentiate different manufacturing processes.	Lecture/PPT	ME1403.1	Quiz Mid term I Assignment
L3	Introduction of casting, Types of patterns.	Distinguish between patterns	Lecture/PPT	ME1403.2	Quiz Mid term I
L4	Pattern allowances. Types of mould.	Identify moulds and apply pattern allowances in pattern making	Lecture/PPT	ME1403.2	Quiz End term Assignment
L5	Sand & sand properties	Identify the sand and use it for making a mould.	Lecture/PPT	ME1403.2	Quiz Mid term I
L6	Melting furnaces	Recognize furnaces	Lecture/PPT	ME1403.2	Quiz Mid term I
L7	Gating design, Cooling & solidification	Describe the gating system design and handling of molten material.	Lecture/PPT	ME1403.2	Quiz Assignment End term
L8	Casting processes:	Able to explain to explain	Lecture/PPT	ME1403	Quiz Mid term I

	Die casting	die casting process		.2	
L9	Shell moulding & investment casting	Explain and implement about shell and investment casting	Lecture/PPT	ME1403 .2	Quiz End term
L10	Centrifugal casting, slush casting & CO2 casting	Identify the product making from these processes.	Lecture/PPT	ME1403 .2	Quiz Mid term I
L11	Defects in casting & inspection techniques	Recall about the various defects and they can find possible solution for the same.	Lecture/PPT	ME1403 .2	Quiz End term Assignment
L12	Introduction of forming process	Distinguish between casting and forming process	Lecture/PPT	ME1403 .1	Quiz
L13	Plastic deformation and yield criteria	Recall various deformation processes	Lecture/PPT	ME1403 .3	Quiz Mid term I
L14	Relation between tensile and shear yield stresses	Understand mechanical properties of plastic	Lecture/PPT	ME1403 .3	Quiz
L15	Hot working & cold working	Examine the various forming based on recrystallization temperature	Lecture/PPT	ME1403 .3	Quiz Assignment
L16	Introduction of rolling & rolling principle	Recall various aspects of the rolling process	Lecture/PPT	ME1403 .3	Quiz Mid term I
L17	Rolling stand arrangement	Design a rolling process using advanced software	Lecture/PPT	ME1403 .3	Quiz
L18	Rolling load, roll passes, Rolling defects	Recall rolling process and examine its defects	Lecture/PPT	ME1403 .3	Quiz End term
L19	Introduction to forging	Learn about forging process and its importance.	Lecture/PPT	ME1403 .1	Quiz Mid term I
L20	Upsetting, smith forging, drop	Able to solve problems in upsetting and smith forging	Lecture/PPT	ME1403 .3	Quiz Mid term I

	forging	and design the same for specific product			
L21	Fullering,edging, blocking, trimming	Recall the various processes and design the same for specific product	Lecture/PPT	ME1403 .3	Quiz End term
L22	Press forging	Recognize press forging	Lecture/PPT	ME1403 .3	Quiz Assignment
L23	Machine forging, Forging defects	Able to solve problems in forging and defects.	Lecture/PPT	ME1403 .3	Quiz End term
L24	Introduction of extrusion & extrusion principle	Recall various metal reduction processes related to the primary manufacturing processes.	Lecture/PPT	ME1403 .3	Quiz Mid term I
L25	Forward, backward, impact extrusion	Learn about various applications of and its usage	Lecture/PPT	ME1403 .3	Quiz End term
L26	Wire drawing, Rod & tube drawing	Learn about importance of various forging process and possible area of application.	Lecture/PPT	ME1403 .3	Quiz Mid term II
L27	Sheet metal operations, blanking, punching	Recall importance of process and possible area of application.	Lecture/PPT	ME1403 .5	Quiz Assignment
L28	Drawing, spinning, bending, embossing & coining	Distinguish about different sheet metal process and application of processes.	Lecture/PPT	ME1403 .5	Quiz Mid tem II
L29	Sheet metal die design	Learn the factors used in sheet metal working and designing of sheet metal die.	Lecture/PPT	ME1403 .5	Quiz Assignment End term
L30	Introduction of welding, types of joints	Distinguish among the welding processes	Lecture/PPT	ME1403 .1	Quiz
L31	Gas welding, oxy acetylene welding equipment	Describe various factors of gas welding and their parameters	Lecture/PPT	ME1403 .4	Quiz End term

L32	oxy acetylene welding techniques & gas cutting	Design their own gas welding process	Lecture/PPT	ME1403 .4	Quiz Mid tem II
L33	Principle of arc welding & arc welding Equipments	Employ the different arc welding for a specific product	Lecture/PPT	ME1403 .4	Quiz Assignment
L34	Electrodes, manual arc welding, carbon arc welding	Recall the various electrode and their importance in welding	Lecture/PPT	ME1403 .4	Quiz
L35	Inert gas shielding arc welding, GTAW	Employ the different arc welding for a specific product	Lecture/PPT	ME1403 .4	Quiz End term
L36	GMAW, Submerge arc welding	Employ the different arc welding for a specific product	Lecture/PPT	ME1403 .4	Quiz Assignment
L37	Principle of resistance welding, resistance welding Equipments	Describe the different types of pressure welding and its importance	Lecture/PPT	ME1403 .4	Quiz Mid term II
L38	Spot welding, seam welding, projection welding	Recall the different types of pressure welding and its applications	Lecture/PPT	ME1403 .4	Quiz End term II

L39	Upset welding, flash welding	Recognize the different types of pressure welding	Lecture/PPT	ME1403.4	Quiz
L40	Thermit welding, Electro slag welding	Describe the thermit & electro slag welding and its application	Lecture/PPT	ME1403.4	Quiz End term
L41	Electron beam welding, laser beam welding	Employ the different types of different welding	Lecture/PPT	ME1403.4	Quiz Mid term II
L42	Forge welding, friction welding, diffusion welding	Distinguish about various solid state welding processes and its application	Lecture/PPT	ME1403.4	Quiz Mid term II
L43	Brazing & soldering	Employ the different types of brazing and soldering	Lecture/PPT	ME1403.4	Quiz Mid term II
L44	Properties of plastic, Additives in plastics	Learn about different constituent of materials and additive materials other than parent material used in plastic industry.	Lecture/PPT	ME1403.5	Quiz Assignment

L45	plastic materials, Extrusion of plastics	Acquire about various types of plastics materials used for plastics and different process of making product.	Lecture/PPT	ME1403.5	Quiz End term
L46	Injection moulding	Recall the importance of injection moulding and possible area of application.	Lecture/PPT	ME1403.5	Quiz Assignment
L47	Blow moulding, Thermoforming	Learn about importance of blow moulding and thermoforming and its applications.	Lecture/PPT	ME1403.5	Quiz End term
L48	Conclusion and Course Summarization	NA	NA	NA	NA

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

CO	**STATEMENT**	CORRELATION WITH PROGRAM OUTCOMES									CORRELATION WITH PROGRAM SPECIFIC OUTCOMES					
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ME1403.1	Know the different manufacturing processes.	2														
ME1403.2	Recognize different casting processes for specific product.	3	2		1											1
ME1403.3	Explain forming processes (forging, rolling and drawing).	3	2		1	1										1
ME1403.4	Describe joining processes and their applications for skill development.	1				1										
ME1403.5	Explain the concepts of processing of plastic.					1										

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

MANIPAL UNIVERSITY JAIPUR

Value, Ethics & Governance BB1101 [2 Credits] [2 0 0 2]

Session: Jan 2019-May 2019 | Faculty: Dr. C.Anirvinna/Mr. Himanshu Priyadarsh | Class: B.Tech.Sem. IV

A. **Introduction:** The course is offered to understand Moral Values and Ethics in personal as well as professional life. It is basic requirement of every human to be a good human being and a good citizen. It further imparts him basics of corporate governance so as to empower him to work technically and professionally in any organization with confidence and conviction and at the same time with honesty & integrity.

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

BB1101.1	Define the meaning and relevance of Value and Ethics and apply in personal & professional life.
BB1101.2	Describe the importance of three Gunas for self-development, lifelong learning & growth.
BB1101.3	Find issues and identify solutions related to Public & Private Governance systems.
BB1101.4	Explain the relevance of Company's Act 2013 with reference to corporate world.
BB1101.5	Explain the role and key objectives of organizational governance in relation to ethics and law.
BB1101.6	Demonstrate the social & environmental responsibilities of corporate for sustainability, harmony, and growth for employability in industries.

C. Program Outcomes and Program Specific Outcomes

PROGRAM 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 environment.

[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

PROGRAM SPECIFIC OUTCOMES

PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software
[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels
[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Mid Sem Exam I (Close Book)	15
	Mid Sem Exam II (Close Book)	15
	In class Quizzes/ Assignments Students' Presentations	20(Min 5 each) 10
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.	

D: **Syllabus:**

Values: Relevance of Value Education in day-to-day life. Mantra for success - Value, Moral and Ethics. Determinants of human nature (Three Gunas) and its impact on human life.

Relevance of traits like Personality, Attitude, Behaviour, Ego, Character, introspection, Motivation, Leadership and 4 Qs with relevant Case Studies.Governance: Understanding of Public and Private sector Governance systems; Courts & CAG. Public Sector Governance: Need, relevance, stakeholders.

Private Sector Governance: Proprietary, Partnership, Company (Pvt Ltd & Ltd), Company' Act 2013, Board of Directors; its Roles and Responsivities. Regulatory bodies; its role in ethical governance.

Projects on PPP mode-relevance & prospects.

CSR: Relationship with Society, Philanthropy and Business strategy, CSR Policy, Triple Bottom Line

Text / Reference Books:

T1. Professional Module of ICSI.
T2. Ghosh B.N., Business Ethics & Corporate Governance, McGraw Hill.
T3. Mandal S.K., Ethics in Business & Corporate Governance, McGraw Hill .
T4. Ray C.K., Corporate Governance, Value & Ethics, Vaya Education of India
R1.Chatterjee Abha, Professional Ethics, Oxford Publications.

***Suggestive Case Studies:**

1) Uphar Theatre Tragedy- Engineering Ethics
2) Bhopal Gas Tragedy- Operational Engineering Ethics
3) Satyam Case- Financial Reporting Ethics
4) Enron Case- Business Ethics
5) Neerav Modi Case- Financial Fraudulence *cases*

E. Lecture Plan:

Lec No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessin the Outcome
1	**Introduction: Values:** Meaning & Relevance of value education	To acquaint and clear teacher's expectations and understand student expectations. Basics of Value Education	Lecture	BB 1101.1	In class Quiz Mid Term I End Term Exam
2	Success: Meaning in perspective of morals & ethics	To understand the concept of success achieved with or without morals / ethics/ values	Lecture, case study	BB 1101.1	In class Quiz Mid Term I End Term Exam
3,4	Professional Ethics & ethical dilemmas Case study-Neerav Modi	To understand the role of professional ethics in the life & deal with dilemmas	Lecture	BB 1101.1	In class Quiz, assignment Mid Term I End Term Exam
5	Three Gunas and their relevance, Nature and kinds of value with examples	Understand basic traits in one's personality, its causes and relevance with value based living.	Lecture	BB 1101.2	In Class Quiz, Mid Term I End Term
6,7	Relevance of traits of individual like Personality, Attitude, Behaviour	To acquaint & develop positive traits of personality in oneself	Short stories, Lecture	BB 1101.2	Class Quiz assignment Mid Term I End Term
8.9	Ego, Character, introspection, Motivation	To acquaint & develop positive traits of personality in oneself and understand negative traits	Lecture Short stories	BB 1101.2	In Class Quiz Mid Term I End Term
10,11	Leadership traits & 4Qs (PQ, IQ, EQ, SQ)	To realize importance of leadership and to imbibe in life	Lecture Short stories	BB 1101.2	In Class Quiz assignment Mid Term I End Term
12,13	Governance & its relevance Case studies- Bhopal Gas & Uphar Cinema	To acquaint with the concept of Governance	Lecture	BB 1101.3	In Class Quiz Mid Term II End Term
14	Public Sector Governance: Need, relevance, stakeholders	Understand various aspects of public sector governance	Lecture	BB 1101.3	Class Quiz, Mid Term II End Term
15	Public Finance, Audit & Control	Understand basics of Public Finance, Check & balance	Lecture Case study	BB 1101.3	Class Quiz, assignment Mid Term II End Term

16,17	Private Sector Governance, proprietary & partnership firms and corporate, PPP mode projects	Understand meaning of proprietary & partnership in a firm / company and perspective in PPP mode	Lecture Short stories	BB 1101.3 & 1101.4	Class Quiz Mid Term II End term
18, 19	Company' Act 2013 : Roles & Responsibilities of Directors & regulatory authorities	Explain various Regulations and practices of Corporate Governance internationally & understand key role of directors	Lecture	BB 1101.4	Class Quiz Mid Term II End Term
20,21	Role of Ethics in Governance Case studies- Satyam & Enron	Recognize the necessity of ethics & transparency in Governance	Movie : Gandhi	BB 1101.5	Class Quiz, assignment Mid Term II End Term
22,23	CSR: Relationship with Society, Philanthropy and Business strategy	To understand the relevance of giving back to society by a corporate & its importance in society	Lecture, case study	BB 1101.6	Class Quiz, End Term
24	CSR Policy, Triple Bottom Line	Understand the concept of TBL in organizational frameworks	Lecture case study	BB 1101.6	Class Quiz assignment End Term
25,26	Students' Presentation	Recall contents and their importance through case studies.	Flipped Class	ALL	Class Quiz End Term

Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BB1101.1	Define the meaning and relevance of Value and Ethics and apply in personal & professional life.						1		2							
BB1101.2	Describe the importance of three Gunas for self-development, lifelong learning & growth.						1		2	1	1		2			1
BB1101.3	Find issues and identify solutions related to Public & Private Governance systems.						1	1		1	2					

BB1 101. 4	Explain the relevance of Company's Act 2013 with reference to corporate world.						1		1	1						
BB1 101. 5	Explain the role and key objectives of organizational governance in relation to ethics and law.						1		2	1			1			1
BB1 101. 6	Demonstrate the social & environmental responsibilities of corporate for sustainability, harmony and growth for employability in industries						1	3				1	1			3

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

MANIPAL UNIVERSITY JAIPUR

School of Business & Commerce
Department of Business Administration
Course Hand-out
Business Management | BB 1540 | 3 Credits | 3 0 0 3
Session: July 2018 – December 2018 | Faculty: Dr.Anuradha Agarwal | Class : B. Tech .Semester V

A. Introduction: This course is offered by Department of Business Administration as compulsory subject, targeting Engineering students to give concept of keeping organizations healthy and viable in today's global competitiveness. A manager links an enterprise with changing environment. Managerial functions are essentially the same everywhere. Yet to get success, managers will have to acquire a global outlook and apply the principles, concepts and theories in an open perspective.

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

[BB1540.1] Explain knowledge in the field of organizational management and internal organization structure required for Managing an enterprise.
[BB1540.2] Describe management, motivation and leadership for developing managerial skills.
[BB1540.3] gain knowledge for starting a small scale unit.
[BB1540.4] Distinguish knowledge on case studies.
[BB1540.5] classify the importance of Management Information System.

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 under - standing 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.

PROGRAM SPECIFIC OUTCOMES:

[PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software
[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels
[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

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 assign ments 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

Meaning and definition of an organization, Necessity of Organization, Principles of Organization, Formal and Informal Organizations. Management: Functions of Management, Levels of Management, Managerial Skills, Importance of Management, Models of Management, Scientific Management, Forms of Ownership, Organizational Structures, Purchasing and Marketing Management, Functions of Purchasing Department, Methods of Purchasing, Marketing, Functions of Marketing, Advertising. Introduction, Functions of Personal Management, Development of Personal Policy, Manpower Planning, Recruitment and Selection of manpower. Motivation – Introduction, Human needs, Maslow's Hierarchy of needs, Types of Motivation, Techniques of Mo tivation, Motivation Theories, McGregor's Theory, Herzberg's Hygiene Maintenance Theory. Leadership - Introduction Qualities of a good Leader, Leadership Styles, Leadership Approach, Leadership Theories. Entrepreneurship – Introduction, Entrepreneurship Development, Entrepreneurial Characteristics, Need for Promotion of Entrepreneurship, Steps for establishing small scale unit. Data and Information; Need, function and Importance of MIS; Evolution of MIS; Organizational Structure and MIS, Computers and MIS, Classification of Information Systems, Information Support for functional areas of management.

F. TEXT BOOKS

T1. Koontz, Harold, Cyril O'Donnell, and Heinz Weihrich: Essentials of Management, Tata McGraw-Hill, New Delhi
T2. Robbins, Stephen P, and Mary Coulter: Management, Prentice Hall, New Delhi

G. REFERENCE BOOKS

R1. E. S. Buffa and R. K. Sarin “Modern Production / Operations Management”, 8th Edition, Wiley, 1987

R2. H. J. Arnold and D. C. Feldman “Organizational Behavior”, McGraw – Hill

R3. Aswathappa K: Human Resource and Personnnel Management, Tata McGraw Hill William Wether& Keith Davis, Human Resource and Personnel Management, McGraw Hill

H. Lecture Plan:

LEC NO	TOPICS
1	Meaning and definition of an organization, Necessity of Organization
2	Principles of Organization, Formal and Informal Organizations
3,4	Management Function: Planning, Organizing, Leading & Controlling
5	Managerial Skills, Importance of Management, Models of Management: Scientific
6	Models of Management: Human approach and Behavioural
7	Forms of Ownership and Organization Structures
8	Purchasing Function
9	Marketing Function
10	Advertising and Changing Dynamics of Advertising
11	Introduction, Functions of Personal Management, Development of Personal Policy, Development of Personal Policy
12	Manpower Planning
13	Recruitment of Manpower
14	Selection of Manpower
15	Introduction to Motivation, Human needs, Maslow's Hierarchy of needs
16,17	Types of Motivation, Techniques of Motivation
18	McGregor's Theory, Herzberg's Hygiene Maintenance Theory
19	Leadership - Introduction Qualities of a good Leader, Leadership Styles
20,21,22	Leadership Approach, Leadership Theories
23	Entrepreneurship – Introduction, Entrepreneurship Development
24	Entrepreneurial Characteristics, Need for Promotion of Entrepreneurship
25	Steps for establishing small scale unit
26,27,28	Data and Information; Need and Importance of MIS, Functions of MIS, Evolution of MIS
29.30	Organizational Structure and MIS, Computers and MIS
31,32	Classification of Information Systems, Information Support for functional areas of management
33, 34	Introduction to case study, types of case study, Steps to solve case study
35,36	Case Study Discussion
37, 38	Revision Class

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
BB1540.1	The students will acquire knowledge in the field of organizational management and internal organization structure required for managing an enterprise.	1	2	3	1			1			1		1	2	1	1
BB1540. 2	Describe management, motivation and leadership for developing managerial skills.	3	2	1	2	1								2		1
BB1540. 3	The students will be able to gain knowledge for starting a small scale unit.	3	3	3	2						1		1	2	1	
BB1540. 4	The students will also gain knowledge on case study and management information system.	3	2	3	2	1		1					1	2		
BB1540. 5	Learn the classification and importance of MIS	2	3	1	1	1							1	2	1	1

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering
Department of Mechanical Engineering
Course Hand-out

Design of Machine elements-I| ME 1506 | 4 Credits | 3 1 0 4
Session: July 18 – Dec 18 | Faculty: Prof Sasanka Sekhar Ghosh, /B.Tech. Semester V

A. . **INTRODUCTION:** This course is offered by Dept. of Mechanical Engineering, targeting students who wish to pursue design, research & development in industries or higher studies in field of Mechanical Engineering, including basics of machine design including the design process, engineering mechanics and materials, failure prevention under static and variable loading. Offers in depth knowledge of practical approach through a wide range of applications and examples of design and analysis. Subject provide the knowledge to analyse the type of loads that are responsible for the failure of parts and prediction of the failure of the parts based on different theories of failure.

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

[ME1506.1]. Describe the design process, material selection, identify stresses for machine components.
[ME1506.2]. Estimate the dimensions of the machine elements which are subjected to static loading.
[ME1506.3]. Design machine elements subjected to fluctuating loads.
[ME1506.4]. Design Shafts, Keys and Couplings.
[ME1506.5]. Design riveted, welded joints, threaded fastener subjected to different loading conditions.
[ME1506.6]. Design Power Screws for various applications in order to enhanced his/her employability.

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.

PROGRAM SPECIFIC OUTCOMES

PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software
[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels
[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

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 (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

Machine Design philosophy. Engineering Materials: Stress-strain diagrams for ductile and brittle materials, Stresses in Machine Elements: Types of simple stresses, State of stress at point-implications, principal stresses and compound stresses. Design for strength: Static loading, Theories of failures, Allowable stress, Factor of safety, Stress concentration factor, curved beams. Variable and impact loading. Shafts - ASME & ISI code equations for design of

transmission shafts, design of shafts subjected to combined load. Key and couplings design. Riveted joints: Structural joints of lap & butt types, Boiler joints, Rivets Coursed to eccentric loading conditions. Welded joints
: Types of welding joints and symbols, Strength of welded joints and Design principle. Eccentric loading in welded joint Threaded fasteners, Power screws

F. TEXT BOOK:

T1. J.E. Shigley and C.R. Mischke, *Mechanical Engineering Design*, McGraw Hill,2003
T2. V. B. Bhandari, Design of Machine Element, McGraw Hill Education Pvt. Ltd., 4th Edition, 2017.

G. REFERENCE BOOKS:

R1. R. L. Norton, *Machine Design-An Integrated Approach*, Pearson Publisher, 5th Edition, 2013.
R2. U.C. Jindal, *Machine Design*, Pearson publisher, 1st Edition, 2010.
R3. V. B. Bhandari, *Machine Design Data book*, McGraw Hill Publication, 2014.

H. LECTURE PLAN:

Lecture S.no.	Portions to be covered	Mode of delivery	Corresponding CO	Mode of assessing the outcome
L1	**Introduction** to machine design	Lecture, PPT	ME 1506.1	Short question
L2	Materials and their properties, Material Specification	Lecture, C&T, PPT	ME 1506.1	Quiz. Mid term I
L3	Stress-Strain diagrams, Strain Energy, Resilience, Toughness, Hardness	Lecture, C&T	ME 1506.1	Quiz
L4	Creep & Temperature, contact stresses,	Flipped Classroom	ME 1506.1	Class Quiz
L5	**Concept of normal and shear stress**	Self study, Activity	ME 1506.1	Quiz, Short question
L6	Concept of bending and torsional shear stress, combined stress	Flipped Classroom	ME 1506.1	Quiz, Short question
L7	**Design based on static load**: Strength Concepts: Principle Stresses, Theories of failure, Factor of Safety	Lecture, C&T	ME 1506.2	Class Quiz, Mid term I
T1	Numerical problems	Flipped Classroom	ME 1506.2	Mid term I
L8	Design and analysis of stresses of curve beam	Lecture, C&T	ME 1506.2	Class Quiz, Home assignment 1
L9	Numerical problems	Lecture, C&T	ME 1506.2	Class Quiz, Mid term I
L10	Design of machine part subjected to static load	Flipped Classroom	ME 1506.2	Class Quiz
L11	**Fluctuating stresses:** Stress concentration factor, Fluctuating stresses, Endurance limit, Notch Sensitivity, S-N diagram	Lecture, C&T	ME 1506.3	Class Quiz
L12	Reverse stresses-design for finite and infinite life	Lecture, C&T	ME 1506.3	Class Quiz, Mid term I
L13	Numerical problems	Lecture, C&T	ME 1506.3	Class Quiz, Home assignment 2
L14	Goodman & Soderberg diagram,	Lecture, C&T	ME 1506.3	Class Quiz, Mid term I
L15	Modified Goodman diagram	Lecture, C&T	ME 1506.3	Mid term I, End term

L16	Stresses due to combined loading	Lecture, C&T	ME 1506.3	Home assignment 3, End term
L17	Numerical problems	Lecture, C&T	ME 1506.3	End term
L18	Summary	Activity, C&T	ME 1506.3	Activity assessment
L19	**Shafts**: Torsion of circular solid & hollow shafts	Lecture, C&T	ME 1506.4	Class quiz
L20	Design of shafts subjected to bending in two planes in addition to axial loads	Lecture, C&T	ME 1506.4	Class quiz
L21	Design of shafts according to ASME code	Lecture, C&T	ME 1506.4	Home assignment 4
L22	Numerical problems	Lecture, C&T	ME 1506.4	Class quiz, Mid term-I
L23	-DO-	Lecture, C&T	ME 1506.4	Quiz, End term
L24	Types of Keys , Stresses in Keys	PPT	ME 1506.4	Class quiz
L25	Design of square Keys, Numerical problems	Lecture, C&T	ME 1506.4	Mid term-I
L26	Types of coupling	PPT	ME 1506.4	Class quiz
L27	Design of Rigid coupling	Lecture, C&T	ME 1506.4	Quiz
L28	Numerical problems	Lecture, C&T	ME 1506.4	Short question
L29	Design of Flexible coupling	Lecture, C&T	ME 1506.4	Home assignment 5
L30	Numerical problems	Lecture, C&T	ME 1506.4	Class quiz
L31	**Riveted joints** : types of joints	Lecture, PPT	ME 1506.5	Class quiz
L32	Strength and efficiency of Riveted joints, Numerical problems	Lecture, C&T	ME 1506.5	Class quiz, Mid term-II
L33	Riveted joints for boiler, Numerical problems	Lecture, PPT, C&T	ME 1506.5	Class quiz, Mid term-II
L34	Riveted joints for eccentric loading, Numerical problems	Lecture, C&T	ME 1506.5	Class quiz, End term
L35	-DO-	Flipped Classroom	ME 1506.5	Class quiz
L36	**Welded Joints:** types of welds, welding symbol	Lecture, PPT	ME 1506.5	Class Quiz
L37	Strength of Weld joint, design principle	Lecture, C&T	ME 1506.5	Class quiz
L38	Numerical problems	Lecture, C&T	ME 1506.5	Mid term
L39	Design for welded joints subjected to eccentric loading	Lecture, C&T	ME 1506.5	Class quiz, Home assignment 6
L40	Numerical problems	Lecture, C&T	ME 1506.5	End term
L41	Summary	Activity	ME 1506.5	Activity assessment
L42	**Threaded Fasteners :** Stresses in Bolts	Lecture, PPT, C&T	ME 1506.5	Class quiz
L43	Effect of Initial Tension	Lecture, C&T	ME 1506.5	Mid term-II
L44	Dynamic and impact loading on bolts	Lecture, C&T	ME 1506.5	Mid term-II
L45	Numerical problems	Flipped Classroom	ME 1506.5	Class quiz, Mid term-II
L46	Bolts subjected to eccentric loading	Lecture, C&T	ME 1506.5	Class quiz
L47	Numerical problems	Flipped Classroom	ME 1506.5	Mid term-II
L48	Summary	Activity	ME 1506.5	Activity assessment
L49	**Power Screws:** Stresses in power screws	Lecture, PPT, C&T	ME 1506.6	Class quiz
L50	Efficiency of power screws	Lecture, C&T	ME 1506.6	Class quiz
L51	Force and Torque requirement to lift load/lower in power screw jack	Lecture, C&T	ME 1506.6	Class quiz
L52	Numerical problems	Lecture, C&T	ME 1506.6	Class quiz

L53	Design process of power screw	Lecture, C&T	ME 1506.6	Class quiz
l54	Application base problems	Lecture, C&T	ME 1506.6	End term
L55	-DO-	Flipped Classroom	ME 1506.6	Quiz, End term
L56	Summary	Activity	ME 1506.6	Activity assessment

I. COURSE ARTICULATION MATRIX (Mapping of COs with POs):

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WIT I 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 1506.1	Describe the design process, material selection, identify stresses for in machine components	2	2	1			1									
ME 1506.2	Estimate the dimensions of the machine elements which are subjected to static loading.	3	3	2	2											
ME 1506.3	Designmachine elements subjected to fluctuating loads.	2	3	3	3											
ME 1506.4	Design Shafts, Keys and Couplings	3	2	3	3											
ME 1506.5	Design riveted, welded joints, threaded fastener subjected to different loading conditions	3	3	3	3											
ME 1506.6	Design Power Screws for various applications in order to enhanced his/her employability	2	2	3	2											

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering
Department of Mechanical Engineering
Course Hand-out
Heat and Mass Transfer| ME 1507 | 4 Credits | 4 0 0 4

Session: July 18 – Dec 18 | Faculty: Prof. G.L. Sharma, Mr. Ankur Srivastava| Class: B. Tech. Sem. V

A. Introduction: This course is offered by Dept. of Mechanical Engineering which focuses on mainly to make students aware of the basic difference between thermodynamics and heat transfer. The course covers various modes of heat transfer with their description and to use this analysis in the various applications like heat exchanger, condenser, evaporator etc. The course also requires a basic knowledge of engineering thermodynamics.

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

[ME1507.1] Understand basics of heat transfer: conduction, convection and radiation

[ME1507.2] Apply principles of heat transfer to engineering systems.

[ME1507.3] Design and analyze the performance of heat exchanging devices to improve the skills for employability.

[ME1507.4] Analyse the performance of phase change devices like evaporator and condenser.

[ME1507.5] Identify difference between heat and mass transfer on the basis of the driving potential governing them.

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 under - standing 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.

[PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software
[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels
[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Open Book)	15
	Sessional Exam II (Open 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

Introduction, Various modes of heat transfer. Conduction, Fourier law of heat conduction, Heat diffus io n equation in Cartesian, Cylindrical and Spherical coordinate system, One dimensional steady state conduction applied to various cases e. g. plane wall, cylinder, sphere etc. Heat transfer from extended surfaces, Critical radius of insulation for cylinder & sphere, overall heat transfer coefficient, Convection, Review of Concept to Boundary Layer, empirical correlation for free & forced convection. Concept of Boiling and Evaporation, Boiling modes, Condensation: physical mechanism, Film and Dropwise condensation. Heat Exchanger, Heat Exchanger Analysis by LMTD and Effectiveness-NTU method. Radiation: - Radiation Intensity, Absorption, Reflection and Transmission by real surfaces, Kirchhoff's Law, Gray surface. Radiation exchange between surfaces, Gray surfaces in an enclosure. Mass transfer: Introduction, diffusion mass transfer, Fick's law of diffusion, steady state molecular diffusion.

F. TEXT BOOKS

- T1.J.P.Holman, *Heat Transfer,* McGraw Hill, New York, 1997.

G. REFERENCE BOOKS

- R1.P.F. Incopera, D.P. Dewitt, *Fundamentals of Heat and Mass Transfer,* John Wiley Publication(2014)
- R2.Yunus , Cengel, *Heat Transfer- A Practical Approach, Mc Graw Hill Publication,* Latest Edition

H. Lecture Plan:

Lecture S.no.	Portions to be covered	Mode of delivery	Corresponding CO	**Mode of assessing the outcome**
L1	Introduction	Lecture	ME1507.1	Class quiz
L2	Thermodynamics and heat transfer, basic modes of heat transfer and laws governing them	Lecture, C& T	ME1507.1	Class quiz
L3	**Conduction:** Conduction Heat Transfer: Fourier Law of heat conduction, Conduction through a plane wall and composite rectangular wall (One dimensional steady state conduction)	Lecture, C&T	ME1507.1	Class quiz
L4	Conduction through a cylindrical wall, composite cylindrical wall, sphere	Lecture, C&T	ME1507.1	Class Quiz
L5	Generalized thermal resistance network	Lecture, C&T	ME1507.1	Quiz, Sessional Exam
L6	Numerical problems	Lecture, C&T	ME1507.1	Class test
L7	Overall heat transfer coefficient, thermal contact resistance, thermal diffusivity	Lecture, C&T	ME1507.1	Class quiz
L8	General heat conduction equation in Cartesian coordinates	Lecture, C&T	ME1507.1	Class test, Sessiona Exam
L9	General heat conduction equation in cylindrical and spherical coordinates	Lecture, C&T	ME1507.1	Class quiz
L10	Lagging of pipes	Lecture, C&T	ME1507.2	Quiz
L11	Numerical problems	Lecture, C&T	ME1507.1	Class Quiz
L12	Critical radius of insulation for cylinder and sphere	Lecture, C&T	ME1507.2	Class quiz
L13	Heat conduction with internal heat generation for a plane wall	Lecture, C&T	ME1507.1	Class quiz, Sessional Exam
L14	Heat conduction with internal heat generation for a cylindrical wall	Lecture, C&T	ME1507.1	Class quiz
L15	Numerical problems	Flipped Classroom	ME1507.1	Assignment
L16	Heat transfer from extended surfaces: Fins, their types and applications	Lecture, C&T	ME1507.2	Quiz
L17	Generalized equation for fins	Lecture, C&T	ME1507.2	Class Quiz
L18	Steady flow of heat along a rod	Lecture, C&T	ME1507.2	Class test
L19	Heat dissipation from an infinitely long fin	Lecture, C&T	ME1507.2	Quiz
L20	Heat dissipation from a fin insulated at the tip	Lecture, C&T	ME1507.2	Quiz
L21	Fin performance- Fin efficiency and effectiveness, design of fins	Flipped Classroom	ME1507.2	Class quiz
L22	Numerical problems	Activity	ME1507.2	Sessional exam
L23	Class Test-I	Lecture, C&T		Quiz
L24	Review Lecture	Lecture, C&T		Class quiz
FIRST				

SESSIONAL EXAM				
L25	**Convection:** Basic concepts, Free and forced convection, Governing law, Viscous and inviscid flow	Lecture, C&T	ME1507.1	Class Quiz
L26	Review of concepts to boundary layer, Laminar boundary layer on a flat plate	Lecture, C&T	ME1507.1	Quiz
L27	Hydrodynamic and Thermal boundary layer, Significance of dimensionless numbers	Lecture, C&T	ME1507.2	Sessional Exam
L28	Drag and skin friction coefficient, Relation between fluid friction and heat transfer	Lecture, C&T	ME1507.2	Sessional Exam
L29	Numerical Problems	Lecture, C&T		Quiz
L30	Empirical correlations for forced convection- Introduction	Lecture, C&T	ME1507.2	Class quiz
L31	Empirical correlations for forced convection- Pipe and Tube flow	Lecture, C&T	ME1507.2	Sessional Exam
L32	Flow across cylinders and spheres	Lecture, C&T	ME1507.2	Assignment
L33	Numerical Problems	Flipped Classroom		Quiz
L34	Empirical correlations for free convection- Introduction, Internal and external flow	Flipped Classroom	ME1507.2	Class quiz
L35	Free convection on a vertical flat plate, free convection for horizontal flat plate (Internal and external flow)	Lecture, C&T	ME1507.1	Quiz
L36	Free convection from horizontal cylinders	Lecture, C&T	ME1507.1	End term Exam
L37	Numerical problems	Lecture, C&T		Quiz
L38	Condensation and Boiling Heat Transfer: Introduction, Boiling and evaporation	Lecture, C&T	ME1507.4	Class quiz
L39	Boiling modes and boiling heat transfer phenomenon, Simplified relations	Flipped Classroom	ME1507.4	Quiz
L40	Condensation mechanism, Film and drop wise condensation	Lecture, C&T	ME1507.4	Class quiz
L41	Numerical problems	Lecture, C&T	ME1507.4	Class test, End term Exam
L42	**Heat exchangers:** types and classifications	Lecture, C&T	ME1507.3	Discussion
L43	Analysis of heat exchangers, LMTD approach	Lecture, C&T	ME1507.3	Class quiz
L44	Effectiveness and NTU approach, Fouling factor	Flipped Classroom	ME1507.3	Quiz
L45	Numerical Problems	Activity	ME1507.4	End term Exam
L46	Class Test-II	Lecture, C&T		Quiz
L47	Review Lecture	Lecture, C&T		Class quiz
SECOND SESSIONAL EXAM				
L48	Radiation**:** Salient features, absorptivity, Reflectivity and Transmissivity, radiation intensity	Lecture, C&T	ME1507.1	Class quiz
L49	Intensity of emitted radiation,	Lecture, C&T	ME1507.1	Class test, End term

	Emissive power, Black body and gray body radiation,			Exam
L50	Kirchoffs law, Stefan Boltzmann law, Radiosity	Flipped Classroom	ME1507.1	Discussion
L51	Radiation exchange between surfaces	Lecture, C&T	ME1507.1	Class quiz
L52	Gray surfaces in an enclosure-Shape factor, reciprocity relation	Lecture, C&T	ME1507.1	End term
L52	Numerical problems	T	ME1507.1	End term
L53	Mass Transfer**:** Introduction, Fick's law of diffusion, Molecular diffusion	Lecture, C&T	ME1507.5	Discussion
L54	Diffusion in solids, liquids and gases	Lecture, C&T	ME1507.5	Discussion
L55	Mass transfer coefficient	Lecture, C&T	ME1507.5	Discussion
L56	Class Test-III			
END SEMESTER EXAMINATION				

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
ME1507.1	Understand basics of heat transfer: conduction, convection and radiation	3	2				1	1					2			
ME1507.2	Apply principles of heat transfer to engineering systems	3	1	1			1						1			
ME1507.3	Design and analyze the performance of heat exchanging devices.	3	2	1	1											
ME1507.4	Analyse the performance of phase change devices like evaporator and condenser.	3	2	1	2									1		
ME1507.5	Identify difference between heat and mass transfer on the basis of the driving potential governing them	3	2	1									1			

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering
Department of Mechanical Engineering
Course Hand-out
Production Technology II | ME 1508 | 4 Credits | 4 0 0 4

Session: July 18 – Dec 18 | Faculty: Dr A K Sharma/ Dr Mithilesh Dikshit/ Mr A Joshi | Class:B.Tech Sem. V

A. Introduction: This course is offered by Dept. of Mechanical Engineering, The course covers concepts of Machining, types of machines, calculations related to machining, economic aspects of machining, metal removal rate and theory of machining. In a production shop, a successful engineer must have a thorough understanding of the subject if he/she has to select and implement the right processes. The selection of the important process parameter is extremely important to achieve the success in manufacturing. The knowledge of correct procedure, machine and parameter leads to the saving of material, rework and labour. Further the subject is very important to deal with real time tool engineering problems.

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

[ME1508.1] Analyse Tool geometry and its attributes, Merchant circle diagram. Tool wear and Tool material.

[ME1508.2] Relate concepts of Machining of components of various sizes and shapes with the help of workshop machines in real time machining environment.

[ME1508.3]Recognize the Operations, Types and Use of Machines like Lathe, Milling, and Drilling etc. for employability.

[ME1508.4] Calculate machining time and metal removal rate.

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 under- standing 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.

Program Specific Outcomes:

[PSO.1].Modelling & Analysis: Model and analyse mechanical engineering components using advanced software

[PSO.2].Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels

[PSO.3].Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

C. Assessment Plan:

Criteria	Description	Maximum Marks
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	Sessional Exam II	15
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X. SYLLABUS

Mechanics of Metal Cutting, Methods of Machining, Types of Cutting Tools, Cutting tool materials, cutting fluids, Nomenclature of Single point cutting tool, Types of chips in machining process, Merchant's Theory, Tool wear and Tool life. Lathe: Introduction to Capstan and Turret lathe. Introduction to shaper, Planer & Slotter. Milling: Mechanics of Milling, Types of Milling Machines and Milling Cutters, Types of Milling processes, Concept of Indexing Mechanism/Dividing Head. Hole Making Operations: Mechanics of Drilling, Nomenclature of Twist Drill Bit, Types of Drilling Machines, Estimation of Machining time & Metal removal rate in Drilling operation. Finishing Operations: Mechanics of Grinding Operation, Specifications and Selection of Grinding Wheels. Lapping, Honing and Buffing, Broaching. Economics of metal machining.

Y. TEXT BOOKS

T1.A. Ghosh, and A.K. Malik, *Manufacturing Science*, Affiliated East West Press Pvt. Ltd., 2nd Edition, 2010.

T2.P.N. Rao, *Manufacturing Technology Volume-2*, McGraw Hill Publication, 4th Edition, 2013.

T3.S. Kalpajian, and S.R. Schmid, *Manufacturing Engineering and Technology*, Pearson Publication, 4th Edition, 2002.

D. REFERENCE BOOKS

R1.P.C. Sharma, *A text book of production technology*, S. Chand Publication, 4th Edition, 2003.

R2. R.K. Jain, *Production technology: Manufacturing Processes, Technology and MEtomation*, Khanna Publication, 17th Edition, 2011.

AA. LECTURE PLAN

Lecture	Topic	Session Outcome	CO	Mode of Delivery	Evaluation
L1	Introduction of Machining, Variety of Machine Tools	Fundamentals of Machining process, Definition of machining and types of machine tools	NONE	Board/PPT	MTE-1/END SEM
L2	Cutting Tools	Definition, Types, Different parts of single point cutting tool	I & II	Board/PPT Prototype model	MTE-1/END SEM
L3	Tool Signature or Tool Nomenclature	Orthogonal rake system (ORS), American Standards Association (ASA)	I	Board/PPT	MTE-1/END SEM
L4	Tool Signature or Tool Nomenclature	Normal Rake System (NRS), Maximum Normal Rake System (MRS)	I	Board/PPT	MTE-1/END SEM Quiz
L5	Mechanism of Chip Formation	Introduction, Types of Chips – Continuous chip without built up edge (BUE), Continuous chip with BUE and Discontinuous	I	Board/PPT	MTE-1/END SEM Assignment Quiz
L6	Factors Affecting Chip Formation and Heat Generation	Depth of cut, feed, cutting velocity	I & II	Board/PPT	MTE-1/END SEM
L5	Cutting Forces in Metal Cutting (Turning)	Force system in turning process, types of forces	I	Board, Machine shop demonstration	MTE-1/END SEM
L6	Orthogonal Cutting Process and Oblique Cutting Process	Fundamentals of orthogonal and oblique machining	I	Board/PPT	MTE-1/END SEM
L7	Mechanics of Orthogonal Metal Cutting	Chip thickness ratio, chip reduction coefficient, Shear	I & II	Board/PPT	MTE-1/END SEM Quiz

		angle, friction angle, cross-sectional area, volume of cut chip			
L8	Mechanics of Orthogonal Metal Cutting	Mass of cut chip, Shear strain, Velocity relationship, volume rate of chip, Shear train rate	I	Board/PPT	MTE-1/END SEM Quiz
L9	Mechanics of Orthogonal Metal Cutting	Determination of cutting forces in turning process (Shear force, Fs, Normal force on shear plane Ns, Friction force F and resultant force etc.)	I	Board/PPT Peer learning in class	MTE-1/END SEM Quiz
L10	Ernst and Merchant's Theory	Establishment a relation among shear angle β, rake angle γ and friction angle η	I	Board/PPT	MTE-1/END SEM
L11	Merchant's Second Solution and Machining Constant	Establishment a relation among shear angle β, rake angle γ and friction angle η and concept of machining constant	I	Board/PPT	MTE-1/END SEM Assignment
L12	Merchant's circle diagram	Drafting Method	I	Board/PPT Peer learning in class	MTE-1/END SEM
L13	Problems on Merchant's Theory	Determination of cutting forces and shear angle etc.	I	Group study in class	MTE-1/END SEM Assignment
L14	Lee and Shaffer's Theory	Relation between various parameters like rake angle, friction angle and shear angle in orthogonal cutting	I	Board/PPT	MTE-1/END SEM Assignment
L15	Cutting Tool Materials	Various types of cutting tools used in machining process, viz. carbon & medium alloys steel, HSS, cast cobalt, carbides, ceramics, coated tools,	I & II	Board/PPT Machine shop demonstration	MTE-2/END SEM Quiz

		CBN, diamond, Ucon, Whisker reinforced tool material			
L16	Cutting Fluids	Definition, function, requirements of good cutting fluid, accesses of cutting fluid to machining zone, main types of cutting fluids.	I & II	Board/PPT	MTE-2/END SEM Assignment
L17	Tool wear	Factors affecting tool wear	I & II	Board/PPT	MTE-2/END SEM Quiz
L18	Tool Life	Taylor's tool life equation and study of different factors affecting tool life	I	Board/PPT Peer leaning in class	MTE-2/END SEM
L19	Lathe	Introduction, Types of Lathe, Accessories	II & III	Board/PPT Machine shop demonstration	MTE-2/END SEM
L20	Lathe Operations	Turning, Facing, Knurling, Parting, Drilling on lathe, Boring	II & III	Board/PPT Machine shop demonstration	MTE-2/END SEM Assignment
L20	Thread Cutting on Lathe	Concept of thread cutting, setting up pitch	III	Board/PPT Machine shop demonstration	MTE-2/END SEM Assignment for making thread
L22	Special Purpose lathe	Capstan and Turret lathe	III	Board/PPT	MTE-2/END SEM Assignment
L23	Introduction to Shaper	Working mechanism and applications	III	Board/PPT Machine shop demonstration	MTE-2/END SEM
L24	Introduction to Planner	Working mechanism and applications	III	Board/PPT Machine shop demonstration	MTE-2/END SEM Quiz
L25	Shaping and Planning	Working mechanism and applications	III	Board/PPT Machine shop demonstration	MTE-2/END SEM
L26	Introduction to Milling	Working mechanism, types and applications	III	Board/PPT	MTE-2/END SEM
L27	Milling Cutters	Various types of milling cutters such as, end milling cutters, peripheral milling cutters, slab milling etc.	III	Board/PPT Live Examples	MTE-2/END SEM Quiz
L28	Milling Operations	Mechanism of milling, chip formation and determination of cutting forces	III	Board/PPT	MTE-2/END SEM Quiz

L29	Indexing	Introduction, need of indexing, various methods of indexing	II & III	Board/PPT Machine shop demonstration	MTE-2/END SEM Assignment
L30	Milling Problems	Indexing	II	Group Study	MTE-2/END SEM Assignment
L31	Introduction to Drilling	Definition, working mechanism, types of drill machines	II	Board/PPT	MTE-2/END SEM
L30	Drilling Mechanism	Geometry of drill bit, nomenclature of twist drill bit, various factors affecting drilling	I & II	Board/PPT	MTE-2/END SEM Quiz
L31	Economics of Drilling	Drilling time estimation, Drilling force estimation and MRR	IV	Board/PPT	MTE-2/END SEM Quiz
L32	Drilling Mechanism Problems		IV	Group Study	END SEM Assignment
L33	Reaming and Jig Boring	Working mechanism and applications	III	Board/PPT	END SEM
L34	Grinding	Introduction, types of Grinding machines , Abrasive Material, Grain Size,	II & III	Board/PPT	END SEM
L35	Grinding Wheel	Bonding Materials, Grinding wheel structure and grade Designation and Selection	I, II & III	Board/PPT	END SEM Quiz
L36	Analysis of the Grinding Process	Speed determination, Material removal rate, Surface finish	II	Board/PPT	END SEM Assignment
L37	Thermal Aspects of Grinding and wheel wear	Temperature at work surface, Attritious wear, Bond fracture, wear curve	IV	Board/PPT	END SEM Qiz
L38	Honing Operation and Its Characteristics	Working mechanism and applications	III	Board/PPT	END SEM
L39	Lapping & Super finishing Operations	Working mechanism and applications	III	Board/PPT	END SEM
L40	Super finishing operations	Burnishing, Magnetic float polishing, Magnetic field assisted polishing	III	Board/PPT	END SEM Assignment/Quiz

		and Electro-polishing			
L41	Broaching and Broaching Machine	Working mechanism and applications	III	Board/PPT	END SEM
L42	Economics of Machining Operations	Machining time estimation, machining cost and economics	IV	Board/PPT	END SEM Assignment
L43	Optimization in Machining	Optimizing Cutting parameters for minimum cost	IV	Board/PPT	END SEM
L44	Optimization in Machining	Optimizing Cutting Parameters for Maximum Production	IV	Board/PPT	END SEM

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

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATIONWITH 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 1508.1	Relate concepts of Machining of components of various sizes and shapes with the help of workshop machines in real time machining environment.	3							1							1
ME 1508.2	Analyse Tool geometry and its attributes, Merchant circle diagram. Tool wear and Tool material.	2		3	2	2		2					2			
ME 1508.3	Recognize the Operations, Types and Use of Machines like Lathe, Milling, and Drilling etc. for employability	2	2		2	2	3	2	2	3			3			2
ME 1508.4	Calculate machining time and metal removal rate.	3	3		3											2
ME 1508.5	Design tool layout and sequence of machining.	3		3		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 Mechanical Engineering

Course Hand-out

Industrial Engineering | ME 1553 | 3 Credits | 3 0 0 3

Session: July 18 – Dec 18 | Faculty: Dr R. K. Gupta / Dr Ashish Goyal | Class: V Semester (Program Elective)

A. Introduction: This course is offered by Dept. of Mechanical Engineering for 5th Semester students, targeting students who wish to pursue research & development in industries or higher studies in field of Mechanical Engineering. It offers in depth knowledge of technical skills and intellectual discipline needed by our graduates to become leaders in industrial engineering and related professions. The course is distinctive in its emphasis on quantitative, economic, computer-aided approaches to production and service management problems. It is focused on providing an experimental and mathematical problem-formulating and problem- solving framework for industrial engineering work. The curriculum provides a broad foundation in the current ideas, models, and methods of industrial engineering.

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

[ME 1553.1]. Understand the basic objectives, principles and techniques of method study as well as various charts used in industries.

[ME 1553.2]. Identify the applicable methods of work measurement and work sampling in the industries.

[ME 1553.3]. Analyse the various techniques to measure and improve the productivity with optimized cost and quality.

[ME 1553.4]. Design the various analytical tools to forecast the resources and demands of the industry for employment in industrial sector.

[ME 1553.5]. Design and apply the various techniques of scheduling jobs on machines along with the aggregate planning, master production schedule.

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 sp ecified 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 under- standing of the limitations.

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PROGRAM SPECIFIC OUTCOMES:

PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software

[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels

[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

D. Assessment Plan:

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	Sessional Exam II (Close Book)	15
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	Total	100

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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 assignme nts with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.

E. Syllabus:

Definition of Industrial Engineering: Objectives, Method study, Principle of motion economy, Techniques of method study - Various charts, THERBLIGS, Work measurement - various methods, time study PMTS, determining time, Work sampling. Productivity- Definitio n, Various methods of measurement, Factors effecting productivity, Strategies for improving productivity. Relevant costs, Costs of quality, Statistical quality Control (SQC), Variables & Attributes, Production Planning & Control (PPC): Introduction to Forecasting - Simple & Weighted moving average methods, Aggregate planning, Master production schedule (MPS), Sequencing- Johnson algorithm for n-Jobs-2 machines, n- Jobs-3 machines, n-Jobs m-machines.

F. Text Books:

T1. S.N. Chary, Production & Operations Management, McGraw Hill Publication, 4th Edition, 2009.
T2. E. E. Adam, R. J. Ebert, Production and Operation Management: Concepts, Models, and Behaviour, Prentice Hall Publishers, 5th Edition, 1992

G. References:

R1.S.S. Buffa, Modern Production Management, John Wiley Publication, 8th Edition, 2007.
R2.P. Kumar, Industrial Engineering and Management, Pearson Publication, New Delhi, 1st Edition, 2015.

H. Lecture Plan:

Lecture Number	Topic to be covered	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome

	Introduction and Course Hand-out briefing	To acquaint and clear teachers expectations and understand student expectations	Lecture/PPT	NA	NA
L1	Definition of Industrial Engineering	Student will able to understand the application of industrial engineering	Lecture/PPT	ME1553.1	Quiz Mid term I Assignment
L2	Method study	Able to understand various manufacturing processes	Lecture/PPT	ME1553.1	Quiz Mid term I
L3	Method study processes	Distinguish between various manufacturing processes	Lecture/PPT	ME1553.1	Quiz End term Assignment
L4	Principle of motion economy	Knowledge about use of various tools.	Lecture/PPT	ME1553.1	Quiz Mid term I
L5	Principle of motion economy	Understand the use of hand body movements	Lecture/PPT	ME1553.1	Quiz Mid term I
L6	Techniques of method study - Various charts	Understand the flow of material	Lecture/PPT	ME1553.1	Quiz Assignment End term
L7	Techniques of method study - Various charts	Understand the movement of worker on shop floor.	Lecture/PPT	ME1553.1	Quiz Mid term I
L8	THERBLIGS	Able to explain various therblings symbols	Lecture/PPT	ME1553.1	Quiz End term

L9	THERBLIGS	Record the figur e movements	Lecture/PPT	ME1553.1	Quiz Mid term I
L10	Work measurement - various methods	Identify differe nt methods of work measurement	Lecture/PPT	ME1553.2	Quiz End term Assignment
L11	Time study	Examine the standard time calculation	Lecture/PPT	ME1553.2	Quiz
L12	Time study	Learn about the performance rating and allowances	Lecture/PPT	ME1553.2	Quiz Mid term I
L13	PMTS	Discuss and understand the function of PMTS	Lecture/PPT	ME1553.2	Quiz
L14	Work sampling	Measure to calculate the standard time with taking random observation	Lecture/PPT	ME1553.2	Quiz Assignment
L15	Productivity	Understand the comparison of Input and output	Lecture/PPT	ME1553.3	Quiz Mid term I
L16	Various methods of measurement of Productivity	Recall methods to calculate partial productivity	Lecture/PPT	ME1553.3	Quiz
L17	Factors effecting productivity	Learn about the use of 3M for productivity improvement	Lecture/PPT	ME1553.3	Quiz End term

L18	Strategies for improving productivity	Recall various strategies for improving productivity	Lecture/PPT	ME1553.3	Quiz Mid term I
L19	Relevant costs	Learn about relevant cost associated with quality	Lecture/PPT	ME1553.3	Quiz Mid term I
L20	Costs of quality	Able to solve problems to examine cost of quality	Lecture/PPT	ME1553.3	Quiz End term
L21	Statistical quality Control (SQC)	Understand the various SQC tool	Lecture/PPT	ME1553.3	Quiz Assignment
L22	Statistical quality Control (SQC)	Able to apply SQC tools for manufacturing industries	Lecture/PPT	ME1553.3	Quiz End term
L23	Variables & Attributes	Able to understand about assignable and chance cause of variation	Lecture/PPT	ME1553.3	Quiz Mid term I
L24	Production Planning & Control (PPC)	Understand the production, planning and production control	Lecture/PPT	ME1553.3	Quiz End term
L25	Production Planning & Control (PPC)	Learn about various functions of PPC	Lecture/PPT	ME1553.3	Quiz Mid term II
L26	Forecasting	Apply the knowledge to forecast of NPD	Lecture/PPT	ME1553.4	Quiz Assignment

L27	Simple & Weighted moving average methods	Able to forecast future demand	Lecture/PPT	ME1553.4	Quiz Mid tem II
L28	Simple & Weighted moving average methods	Able to forecast future demand	Lecture/PPT	ME1553.4	Quiz Assignment End term
L29	Aggregate planning	Learn the various planning Methods	Lecture/PPT	ME1553.5	Quiz
L30	Aggregate planning	Able to determine intermediate planning and line balancing	Lecture/PPT	ME1553.5	Quiz End term
L31	Master production schedule (MPS)	Describe various factors MPS	Lecture/PPT	ME1553.5	Quiz Mid tem II
L32	Master production schedule (MPS)	Understand about the individual ual product planning to be produced	Lecture/PPT	ME1553.5	Quiz Assignment
L33	Sequencing - Johnson algorithm	Solve the problems based On Johnson Algorithm	Lecture/PPT	ME1553.5	Quiz
L34	n-Jobs-2 machines	Able to apply the knowledge to arrange jobs and machines for make spantime	Lecture/PPT	ME1553.5	Quiz End term

L35	n-Jobs-2 machines	Able to apply the knowledge to arrange jobs and machines for make span time	Lecture/PPT	ME1553.5	Quiz Assignment
L36	n- Jobs-3 machines	Able to apply the knowledge to arrange jobs and machines for make span time	Lecture/PPT	ME1553.5	Quiz Mid term II
L37	n- Jobs-3 machines	Able to apply the knowledge to arrange jobs and machines for make span time	Lecture/PPT	ME1553.5	Quiz End term II
L38	n-Jobsm-machines.	Able to apply the knowledge to arrange jobs and machines for make span time	Lecture/PPT	ME1553.5	Quiz
L39	Conclusion and Course Summarization	NA	NA	NA	NA

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

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
[ME 1553.1]	Understand the basic objectives, principles and techniques of method study as well as various charts used in industries.				2	1				1	1	3	1			
[ME 1553.2]	Identify the applicable methods of work measurement and work sampling in the industries.		1	2	1	1						2	1			
[ME 1553.3]	Analyse the various techniques to measure and improve the productivity with optimized cost and quality.	1	1	1	2	2			1	2	1	3	1			
[ME 1553.4]	Design the various analytical and tools to forecast the resources and demands of the industry for employment in industrial sector		1	1	2	1				1	1	2	1			
[ME 1553.5]	Design and apply the various techniques of scheduling jobs on machines along with the aggregate planning, master production schedule.	1	1	1	2	2				2	1	3	1			

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering
Department of Mechanical Engineering
Course Hand-out
Turbo machinery | ME 1555 | 3 Credits | 3 0 0 3
Session: July 18 – Dec 18 | Faculty: Dr.Vinod Yadav/B.Tech. Sem. V

A. **Introduction:** This course is an application of many other courses. These other courses include: Applied Mechanics; Fluid Mechanics; Thermodynamics; Machine Design and Strength of Materials. The course aims at giving an overview of different types of turbo-machinery used for energy transformation, such as pumps, fans, compressors, as well as hydraulic, steam and gas-turbines. It will focus on applications in power generation, transport, refrigeration and the built environment.

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

[ME 1555.1] Recognize typical designs of turbomachines and understand the working principles of turbomachines and apply it to various types of machines.

[ME 1555.2] Determine the velocity triangles and perform the preliminary design of turbomachines (pumps, compressors, turbines).

[ME 1555.3] Recognize relations between choices made early in the turbomachinery design process and the final components and operability.

[ME 1555.4] Recognize and discuss today's and tomorrow's use of turbomachines for enabling a sustainable employability.

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 under- standing 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.

PROGRAM SPECIFIC OUTCOMES:

[PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software

[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels

[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

D. Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	15
	Sessional Exam II (Close Book)	15
	Quizzes (Open Book/Close Book) and Assignments	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.	
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

Basic Concepts of Turbo Machines: Basic laws and governing equations, continuity equation, steady flow energy equation, Newton's 2nd law of motion applied to turbomachines - Euler's pump equation and Euler's turbine equation, dimensional analysis applied to hydraulic machines, power coefficient, flow coefficient, head coefficient, non-dimensional specific speed, Dimensional analysis applied to compressible flow machines. Centrifugal Turbine and Fans: Velocity diagrams, slip factor, energy transfer, power input factor, stage pressure rise and loading coefficient, pressure coefficient, degree of reaction, Centrifugal compressor characteristic, surging, rotating Stall and Choking. Axial Flow Turbine and Fans, turbine versus compressor blades, Axial flow compressors, working principle, velocity triangle, stage work, work done factor, stage loading, degree of reaction; vortex theory, Introduction to blade design, cascade test, compressibility effects, operating characteristics.

F. Text Book:

T1. A.T. Sayers, *Hydraulic & Compressible flow Turbomachines*, McGraw Hill Publication, 1990.

T2. S.L. Dixon, *Fluid Mechanics, Thermodynamics of Turbomachinery*, Pergamon, 2006.

G. Reference Book:

R1. S.M. Yahya, *Turbomachines*, Satya Prakashana, New Delhi, 2005.

R2. S.M. Yahya, *Turbines Compressors and Flans*, McGraw Hill Publication, 2005.

J. Lecture Plan:

Lec No	Topics	Session Objective	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Course Hand-out briefing	To acquaint teacher's expectations and understand student expectations	Lecture	NA	NA
2	Introduction to Turbo Machines	Know the basics of the course and understand its applications	Lecture	ME1555.3 ME1555.4	NA
3	Review of Fluid Mechanics	Brief about the basics of Fluid mechanics	Lecture	NA	NA
4	Basic laws and governing equations	Brief about the basics of Fluid mechanics, laws and governing equations	Flip class	ME1555.1	Class Quiz
5	Continuity equation	Understand the flow of energy	Lecture, activity	ME1555.1	Home Assignment Mid-Term I End-Term
6	Steady flow energy equation				
7	Newton's 2nd law of motion applied to turbomachines	Brief about the thermodynamics and Know the genesis Newton's 2nd law	Flip class	ME1555.1 ME1555.2	Home Assignment and Class Quiz Mid-Term I End-Term
8	Euler's pump equation	Use of Euler's equation for turbo machinery	Lecture, activity	ME1555.1 ME1555.2	
9	Euler's turbine equation	Use of Euler's equation for turbo machinery	Lecture, activity	ME1555.1 ME1555.2	
10	Review and Class Quiz	Assessment and Revision of concepts	activity	NA	NA
11 to 13	Dimensional analysis applied to hydraulic machines	Understand the dimensional analysis and performance parameters	Lecture/ Flip class	ME1555.1 ME1555.1	Home Assignment and Class Quiz Mid-Term I End-Term
14 & 15	Dimensional analysis applied to compressible flow machines			ME1555.1 ME1555.2	
16	Centrifugal Turbine and Fans (I)	Analyse the Velocity diagrams,	Lecture/Activity	ME1555.1 ME1555.2 ME1555.3	Home Assignment and Class Quiz Mid-Term II End-Term
17	Centrifugal Turbine and Fans (II)	Analyse the slip factor, and energy transfer	Lecture/Activity	ME1555.1 ME1555.2 ME1555.3	
18	Centrifugal Turbine	Analyse the power	Lecture/Activity	ME1555.1	

	and Fans (III)	input factor, stage pressure rise and		ME1555.2 ME1555.3	
19	Centrifugal Turbine and Fans (IV)	Analyse the loading coefficient, pressure coefficient, degree of reaction.	Lecture/Activity	ME1555.1 ME1555.2 ME1555.3	
20	Review and Class Quiz	Assessment and Revision of concepts	activity	NA	NA
21	Characteristic of Centrifugal compressor	Know the genesis of centrifugal compressor	Lecture	ME1555.1 ME1555.2	Home Assignment and Class Quiz Mid-Term II End-Term
22	Centrifugal compressor	Understand the surging, rotating Stall and Choking of centrifugal compressor	Lecture	ME1555.2 ME1555.3	
23	Centrifugal compressor continue .				
24	Axial Flow Turbine	Explain the axial flow turbine and fans	Lecture	ME1555.1 ME1555.2	
25	Fans				
25 & 26	Turbine versus compressor blades	Differentiate turbine and compressor blades	Lecture/ Flip class	ME1555.3 ME1555.4	Home Assignment and Class Quiz End-Term
27	Axial flow compressors (I)	Explain the working principle of axial flow compressor	Lecture	ME1555.1 ME1555.3	
28	Axial flow compressors (II)	analyse velocity triangle	Lecture/ Flip class	ME1555.2 ME1555.3	
29	Axial flow compressors (III)	Analyse the stage work, work done factor, stage loading,	Lecture/ Flip class	ME1555.2 ME1555.3	
30	Axial flow compressors (IV)	Analyse the degree of reaction; vortex theory	Lecture	ME1555.2 ME1555.3	
31	Introduction to blade design	Know the genesis of blade design	Lecture	ME1555.1 ME1555.3	Class Quiz
32	Cascade test	Understand Cascade test	Lecture	ME1555.3 ME1555.4	Home Assignment and Class Quiz End-Term
33	compressibility effects	Describe the compressibility effects	Lecture	ME1555.3 ME1555.4	
34 & 35	operating characteristics	Recall operating characteristics	Lecture	ME1555.3 ME1555.4	

K. 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
ME1555.1	Recognize typical designs of turbomachines and understand the working principles of turbomachines and apply it to various types of machines.	3	3	3	3											
ME1555.2	Determine the velocity triangles and perform the preliminary design of turbomachines (pumps, compressors, turbines).	3	2	3	2											
ME1555.3	Recognize relations between choices made early in the turbomachinery design process and the final components and operability.	3	2													2
ME1555.4	Recognize and discuss today's and tomorrow's use of turbomachines for enabling a sustainable employability.	3					3	3		1			2			

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering
Department of Mechanical Engineering
Course Hand-out
Composite Materials | ME 1556 | 3 Credits | 3 0 0 3
Session: July 2018 – Dec 2018 | Faculty: Dr. Subrata B Ghosh | Class: B. Tech. Sem. V

A. INTRODUCTION: This course is offered by Department of Mechanical Engineering as programme elective. Students will learn how composite materials are designed, processed and manufactured. This course will discuss the influencing parameters and structure-property correlations in particulate, fibre, structural composites, biocomposites and nanocomposites, It will help understand the subject with ease by presenting the content in a simplified and logical sequence. It will aid the teaching learning process through relevant illustrations, animations, web content and practical examples. The course will highlight important concepts for each topic covered in the subject. Finally this course will provide opportunity of self-evaluation on the understanding of the subject matter.

B. COURSE OUTCOMES: At the end of the course, students will

[1556.1] The aim is to explain the basic fundamentals of composite materials.
[1556.2] This course will familiarize the students with various composite materials from the viewpoint of applications, properties, characterizations and performance improvements required for improving research skills.
[1556.3] This course will discuss the influencing parameters and structure-property correlations in various composite materials.
[1556.4] This course will also combine particulate, fibre, structural composites, biocomposites and nanocomposites. Composites micromechanics, advanced inspection and nondestructive testing (NDT) of composite parts supported with various case studies will also be covered.

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.

PROGRAM SPECIFIC OUTCOMES

PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software
[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels
[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

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

Definition and Classification of Composites.Reinforcing fibres- Natural fibres (cellulose, jute, coir etc), boron, carbon, ceramic glass, aramids, etc. Short and continuous fibre reinforced composites. Particulate fillers-importance of particle shape and size.Matrix resins-thermoplastics and thermosetting matrix resins. Coupling agents-surface treatment of fillers and fibres, significance of interface in composites.Fabrication techniques pultrusion, filament winding, prepreg technology, injection and compression moulding, resin transfer moulding, reaction injection moulding etc.Biocomposites, Nanocomposites Micromechanics of composites. Properties and performance of composites. Applications. Mechanisms of fracture in composites.
Property evaluation and NDT of composites.

Prescribed Text Book

T1. F.L. Matthews and R.D. Rawlings, Composite Materials: Engineering and Science, Chapman

& Hall, London.

Reference Books

R1. K.K. Chawla, Composite Materials – Science & Engineering, Springer-Verlag, New York.

R2. Carlsson, L. A., Pipes, R.B., Experimental Characterization of Advanced Composite Materials, Prentice-Hall, Inc., New Jersey.

R3.. L., E. Nielsen and R. F. Landel, Mechanical Properties of Polymer and Composites, Marcel Dekker Inc.

F. LECTURE PLAN

Lecture	Topic	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
L1	Introduction, Scope and Objectives of the Course	To acquaint and clear teachers expectations and understand student expectations	Lecture/PPT	**[1556.1]**	NA
L2	Classification of Composite Materials	Students will understand the importance of 'Composite Materials'	Lecture/PPT	**[1556.1]**	Mid-Term 1 Quiz
L3-L4	Designing with Composites	Students will be able to understand different design strategies	Lecture/PPT	**[1556.2]**	Quiz
L5-L6	Polymer Matrix Resins- Thermoplastics and Thermosetting resins	Discussion on differe nt types of polymer matrices	Lecture/PPT	**[1556.2]**	Mid-Term 1 Quiz
L7-L9	Metal Matrix Composites, Ceramic Matrix Composites	Discussion on differe nt types of metal matrices	Lecture/PPT	**[1556.2]**	Assignment
L10-L11	Reinforcing Fibres- Synthetic and Natural Fibres	Discuss different types of reinforcements	Lecture/PPT	**[1556.2]**	Mid-Term 1 Quiz
L12-L13	Short and Continuous Fibre Reinforced Composites	Understand effect of various short and continuous fibre reinforcements	Lecture/PPT	**[1556.3]**	Mid-Term 1
L14	Particulate Fillers- Importance of Particle Shape and Size	Students will understand effect of different types of particulate fillers	Lecture/PPT	**[1556.3]**	Quiz
L15	Concepts Check, Numericals, Problem Solving	Problem Solving	Lecture/PPT	**[1556.3]**	Mid-Term 1
L16-L17	Structural Reinforcements: Fabric Reinforcements	Students will understand about various types of structural reinforcement.	Lecture/PPT	**[1556.3]**	Quiz

L18	Sandwich Construction	Students will understand effect of dislocations and their effects.	Lecture/PPT	**[1556.3]**	Mid-Term 1 Quiz
L19	Concepts Check, Numericals, Problem Solving	Problem Solving.	Lecture/PPT	**[1556.3]**	Mid-Term 1 Quiz
L20	Interfacial Adhesion	Students will understand importance of interfac ia l adhesion	Lecture/PPT	**[1556.3]**	Mid-Term 1 Quiz
L21-L22	Composite Manufacturing Processes-Fabrication Techniques	Learn about various manufacturing processes of composites	Lecture/PPT	**[1556.3]**	Mid-Term 1 Quiz
L23-L25	Characterization Techniques of Composites	Learn about various characterization techniques	Lecture/PPT	**[1556.3]**	Mid-Term 1 Quiz
L26	Concepts Check, Numericals, Problem Solving	Problem Solving	Lecture/PPT	**[1556.3]**	Mid-Term 1 Quiz
L27	Quiz 1 and Assignment topics	Learn about overall composites manufacturing	Lecture/PPT	**[1556.3]**	Quiz
L28-L30	Micromechanics of Composites	Understand composite micromechanics to evaluate composite properties	Lecture/PPT	**[1556.3]**	Quiz & Assignment
L31-L32	Biocomposites-Materials Selection and Design considerations	Learn about various biocomposites, properties, applications, manufacturing	Lecture/PPT	**[1556.3]**	Mid-Term 2
L33	Nanocomposites-Opportunities and Challenges	Students will learn importance ofvarious nanocomposites	Lecture/PPT	**[1556.3]**	Mid-Term 2
L34-L36	Properties and Performance of Composites	Learn about various properties of composites	Lecture/PPT	**[1556.3]**	Quiz
L37	Concepts Check, Numericals, Problem Solving	Problem Solving.	Lecture/PPT	**[1556.3]**	Mid-Term 2
L38	Applications of Composite Materials	Understand various metal fabrication techniques.	Lecture/PPT	**[1556.3]**	Mid-Term 2
L39-L40	Inspection and Testing of Composites	Learn about various NDT techniques used in composites	Lecture/PPT	**[1556.3]**	Mid-Term 2

A. 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
[1556.1]	The aim is to explain the basic fundamentals of composite materials.	3		1		2	3	1	1	1		1	2	3	2	1
[1556.2]	This course will familiarize the students with various composite materials from the viewpoint of applications, properties, characterisations and performance improvements required for research skills.	3	1	1		2	1		1		1	1	1	2	3	2
[1556.3]	This course will discuss the influencing parameters and structure-property correlations in various composite materials.	3	2		1	1	2	1		2	2	1		1	1	3
[1556.4]	This course will combine particulate, fibre, structural composites, biocomposites and nanocomposites. Composites micromechanics, advanced inspection and nondestructive testing (NDT) of composite parts supported with various case studies will also be covered.	3	1	1		1	1	1		1	2		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 Mechanical Engineering

Course Hand-out

Machine Design - II | ME 1605 | 4 Credits | 4 0 0 4

Session: Jan 19 – May 2019 | Faculty: Prof. Sasanka Sekhar Ghosh/ Mr. Rakesh B.Tech Sem. VI

A. INTRODUCTION: This course is offered by Dept. of Mechanical Engineering, targeting students who wish to understand analysis and design of important machine elements, pursue research & development in industries or higher studies in field of Mechanical Engineering, including advanced basics of machine element designing including the design process, engineering mechanics and materials, failure prevention under static and variable loading for different elements like springs, gears (Spur, Helical), bearings (journal and anti-friction). This course offers in depth knowledge of practical approach through a wide range of applications and examples of design and analysis. Subject provide the knowledge to formulate the problem, generation of machine element by standard methods and data sheets, based upon previously learned failure criteria.

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

[ME 1605.1]	Select the proper spring, spring arrangement and design various type of springs (Helical Compression, multileaf) for static and fluctuating load.
[ME 1605.2]	Analyse load and design of Gear (spur, helical etc.)
[ME 1605.3]	Compute equivalent radial loads for rolling contact bearing & select appropriate bearing for the application.
[ME 1605.4]	Analyse the pressure distribution and design of journal bearing.
[ME 1605.5]	Analyse and design of belt drives, rope drive and chain drive and apply the required skills in industrial 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.

Program Specific Outcomes

PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software
[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels
[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

D. ASSESSMENT PLAN:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Open Book)	15
	Sessional Exam II (Open 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 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.	

E. SYLLABUS

Spring design: introduction and spring materials. Design of Helical springs for static and fluctuating loads, buckling of compression springs.Gear design: introduction, Gear manufacturing and Gear materials, load analysis on gear tooth, Calculation of Virtual number of teeth and Contact Ratio, Stresses on gears. Lubrication of Gearings.Bearing and Lubrication: Introduction of Bearings, Bearing load life at rated reliability and section of Antifriction Bearings. Lubrication for Antifriction Bearing, mounting and enclosures.Journal Bearing: Types of journal bearings and lubrications, Material combination in Journal bearings, Hydrodynamic lubrication theory, Design of Hydrodynamic bearings and Non-conforming Contacts.

1. Design of Flexible Mechanical elements: Introduction, design of flat belt and V- belt, design of flywheel wire rope design. Design of chain drives.

F. TEXT BOOK:

T1.J.E. Shigley and C.R. Mischke, Mechanical Engineering Design, McGraw Hill Publication, 7th Edition, 2003.
T2.V. B. Bhandari, Design of Machine Elements, McGraw Hill Education (India) Pvt. Ltd.

G. REFERENCE BOOKS:

R1.R. L. Norton, Machine Design-An Integrated Approach, Pearson Publisher, 5th Edition, 2013.
R2.U.C. Jindal, Machine Design, Pearson publisher, 1st Edition, 2010.
R3. V. B. Bhandari, Machine Design Data book, McGraw Hill Education (India) Pvt. Ltd.

H. LECTURE PLAN:

Lec No	**Topics**	**Session Outcome**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing the Outcome**
1	(i) Introduction to the course. (ii) Type of Springs and Connection of spring series and Parallel.	To acquaint and clear teachers expectations and understand student expectations	Lecture	(i) NA (ii) 1605.1	NA
2	Stresses and Deflection in Helical springs.	Recall working of springs, how deformation takes place	Flipped Classroom	1605.1	In Class Quiz (Not Accounted)
3,4	Compression Springs.	Identify different types of compression springs	Lecture	1605.1	In Class Quiz End Term
5,6	Spring Materials	Explain about spring material and its uses	Self-Study/ PPT	1605.1	Home Assignment End Term
7	Design of Helical Springs, Critical frequency of Helical Springs	Using the standard procedure design helical gears and find out its critical frequency	Lecture	1605.1	In Class Quiz End Term
8,9	Fatigue Loading On spring,	Recall and discuss about endurance limit, design for fatigue loading	Activity (Think Pair Share)	1605.1	Class Quiz Mid Term I End Term
10,11, 12	Problems on Spring (Numerical, Doubts), leaf spring	Solve numerical problems based on design of spring	Activity (Jigsaw)	1605.1	Class Quiz Mid Term I End term
13, 14	Types and Nomenclature of gears , Conjugate action and Involute Properties, Fundamentals of gears	Recall law of gearing, nomenclature and discuss about the involute and cycloidal tooth profile	Flipped Class	1605.2	Home Assignment Class Quiz Mid Term I End Term
14,15	Forming of gear teeth and Interferences, manufacturing of gears, Gear trains, Numerical Problems, gear material	Discuss about gear manufacturing process, recall gear train and some problem based on gear train	Activity (Think Pair Share)	1605.2	Class Quiz Mid Term I End Term
16, 17	Spur Gear- Static Force analysis on gears teeth	Analyse and discuss about force which acts on gear teeth	Lecture	1605.2	Class Quiz Mid Term I End Term
18	Analyses of strength of gear teeth	Interpret and analyse the beam strength of gears	Lecture	1605.2	Class Quiz Mid Term I End Term
19	Dynamic Effects of forces on gear teeth	Examine the dynamic effects of force on gear teeth	Jigsaw	1605.2	Class Quiz Mid Term I End Term
20,21	Estimation of Gear size, Fatigue Strength and consideration of Factor of safety, Surface durability and surface Fatigue strength	Evaluate the gear dimension, fatigue strength, FoS and surface durability of beam strength	Lecture, Activity	1605.2	Class Quiz Mid Term I End Term
22,23	Heat dissipation , Discussion	Describe working heat dissipation in gears	Lecture, Activity	1605.2	Class Quiz Mid Term II End Term
24,25	Helical Gear, Terminology of Helical Gear, Virtual number of	Recall the gear nomenclature and calculate the virtual	Lecture	1605.2	Class Quiz Mid Term II End Term

	teeth	number of teeth			
26,,27,28	Force Analysis, beam strength of Helical gears	Describe the working of forces, evaluate the beam strength of gears	Lecture	1605.2	Class Quiz End Term
29,30	Effective load on gear tooth, wear strength of Helical gears	Evaluate the effective load on gears as well as its wear strength	Flipped Class	1605.2	Class Quiz End Term
31	Introduction of Bearings and types of bearings	Describe the working and types of bearings	Flipped Class	1605.3	Class Quiz End Term
32, 33	Life analysis of Ball bearing and roller contact bearing.	Examine the life of a ball and roller contact bearing	Flipped Class	1605.3	Class Quiz End Term
34	Load analysis of Ball bearing and roller contact bearing.	Evaluate the load of ball and roller bearing	Flipped Class	1605.3	Class Quiz End Term
35,36	Selection of Ball and roller contact bearing.	Describe the selection procedure of ball and roller bearings	Flipped Class	1605.3	Class Quiz End term
37	Lubrication and Mounting and enclosure.	Identify different types of lubricants, mounting and enclosure	Lecture	1605.3	Class Quiz Mid Term II End Term
38,39	Viscosity and Petroff's Law.	Discuss about viscosity of a fluid and describe the Petroff;s law	Flipped Classroom	1605.4	Class Quiz Mid Term II End Term
40	Stable Lubrication and Thick Film Lubrication.	Examine stable and thick film lubrication and discuss the influence of lubrication	Flipped Classroom	1605.4	Class Quiz Mid Term II End Term
41,42	Hydrodynamic theory and Design Consideration.	Describe hydrodynamic theory and discuss the design consideration	Flipped Classroom	1605.4	Class Quiz End Term
43,44	Bearing Performance	Describe about the performance of bearing	Flipped Classroom	1605.4	Class Quiz End Term
45,46	Design of Belt drive	Discuss the design procedure of belt drives	Flipped Classroom	1605.5	Class Quiz End Term
47	Analysis of Belt tension	Analyse the effect of tension in belt drive	Flipped Classroom	1605.5	Class Quiz End Term
48	Condition for Maximum power	Evaluate the condition for maximum power transmission	Lecture, Activity	1605.5	Class Quiz Mid Term II End Term
49,50	Selection of Flat-belts Design of Flat belt drives	Discuss the selection procedure of flat belt drives	Lecture, Activity	1605.5	Class Quiz Mid Term II End Term
51,52	Selection of V-belts, numerical	Describe the selection procedure of V belt drive	Lecture	1605.5	Class Quiz Mid Term II End Term
53,54	Chain drive	Discuss in brief about chain drive	Flipped Classroom	1605.5	Class Quiz End Term
55	Sprocket wheels ,Chain lubrication	Recall about the lubrication and sprocket wheels working procedure	Lecture, Activity	1605.5	Class Quiz Mid Term II End Term
56	Rope, types, specification, design of rope drive	Describe about rope drive and analyse the design procedure of rope drive	Lecture, Activity	1605.5	Class Quiz Mid Term II 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
[ME 1605.1]	Select the proper spring, spring arrangement and design various type of springs (Helical Compression, multileaf) for static and fluctuating load.	2	2	3	3	1	1							1		
[ME 1605.2]	Analyse load and design of Gear (spur, helical etc.)	3	3	3	3	1	1									
[ME 1605.3]	Compute equivalent radial loads for rolling contact bearing & select appropriate bearing for the application.	3	3	3	3	1	1									
[ME 1605.4]	Analyse the pressure distribution and design journal bearings.	3	3	3	3	1	1									
[ME 1605.5]	Analyse and design of belt drives , rope drive and chain drive and apply the required skills in industrial applications.	2	2	3	3	1	1							1		

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering
Department of Mechanical Engineering
Course Hand-out
Internal Combustion Engines| ME 1606 | 4 Credits | 3 1 0 4
Session: Jan 19 – May 19 | Faculty: Mr. Sumit Taneja/ Mr. Mayank Modak/ Mr. Vinoth | Class: B. Tech. Sem. VI

A. Introduction: Perhaps the invention of the engine, or even introducing its concept, was the most important scientific event in the human history. Replacing the horse carriage by the automobile or the horse-less carriage, as it was initially called, was an event that increased the distance human beings can endeavour into space. Engines are basic mechanical engineering devices, and they have variety of applications in moving and non-moving machines.

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

[ME1606.1]. Compare the working of 4-S & 2-S Engine for both SI & CI.
[ME1606.2]. Design the model of conventional I C engines.
[ME1606.3]. Solve & analyse the performance parameters of I C engines.
[ME1606.4]. Compare and categorize the alternate fuels in IC engines.
[ME1606.5]. Analyse the process of different types of systems & components working together in I C engines.
[ME1606.6]. Develop some additional processes to advance the performance of I C engines for entrepreneurship skills.

C. Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	15
	Sessional Exam II (Close Book)	15
	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.	

D. Syllabus

History of IC engines: Nomenclature, Classification & Comparison, SI & CI, 4stroke- 2 stroke, First Law analysis, Energy Balance. Fuel-air cycles, Actual cycles. **Testing & Performance**: Performance parameters, Measurement of operating parameters e.g. speed, fuel & air consumption, Powers, IHP, BHP, FHP, Efficiencies Thermal, Mechanical, Volumetric, Emission Measurement, Indian & International standards of Testing, Emission. **Fuel**: Conventional Petroleum, structure, Refining Fuels for SI & CI engines, Knock rating, Additives, Fuels for Turbine & Jet Propulsion. **Introduction of alternate fuels. Fuel & Combustion**: Combustion in CI & SI engines, Ignition Limits, Stages of combustion, Combustion parameters. Delay period and Ignition Lag, Turbulence and Swirl, Effects of engine variables on combustion parameters, abnormal

combustion in CI & SI engines, Detonation & knocking, Theories of detonation, Control of abnormal combustion, Combustion chamber design principles, Types of combustion chamber. **Engine Systems & Components**: Fuel System (**SI Engine**), Carburetion & Injection, process & parameters, properties of A/F mixture, Requirements of A/F ratios as per different operating conditions, Carburetors, types, Aircraft carburetor, comparison of carburetion & injection, F/A ratio calculations. **CI engine**: Mixture requirements & constraints, Method of injection, Injection systems, CRDI etc. system components, pumps injectors. **Ignition system**: Conventional & Modern ignition systems Magneto v/s Battery, CB point v/s Electronic ignition, Fuel Ignition Energy requirements. Spark advance, centrifugal, vacuum Firing order, spark plugs. **Engine Friction & Lubrication** : Determination of friction, Lubrication principles, Types of lubrication, Places of lubrication Bearings and piston rings etc., Functions of Lubrication, Properties, Rating and Classification of lubricating oil, Additives, Lubrication systems. **Engine Cooling**: Requirements of cooling, Areas of heat flow, High temperature regions of combustion chamber. Heat Balance, Cooling Systems, Air, Water Cooling, Cooling system components. **Supercharging**: Objectives, Thermodynamic cycle & performance of super charged SI & CI engines, Methods of super charging, Limitations, Two stroke engines: Comparison of 4s & 2s engines construction & valve lining scavenging. Process parameters, systems, supercharging of 2 stroke engines. **Turbocharging. Dual & Multi fuel engines**: Principle, fuels, Combustion, performance Advantages, Modification in fuel system. **Special Engines**: Working principles of Rotary, Stratified charge, Free piston, Variable compression ratio engines.

E. Text Books

T1. John B. Heywood, *Introduction to Internal Combustion Engines*, McGraw Hill, 2000.
T2. Mathur and Sharma, *A Course in I C engines*, Dhanpath Rai Publisher, 1981.
T3. Ganeshan, V., Internal Combustion Engine, McGraw Hill Education (India).

F. Reference Books

R1. C.Ferguson, Internal Combustion Engines, John Wiley & Sons, 2004.
R2. R.Stone, Introduction to Internal Combustion Engines, The McMillan Press,
1999. R3. L.C. Lichty, International Combustion Engines, McGraw Hill New Delhi,
1951.
R4. Edward Obert F., Internal Combustion Engines, Harper and Raw Publisher.

G. Lecture Plan:

Lec No	**Topics**	**Session Outcomes**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing the Outcome**
1	**Introduction to IC Engines:** Basic Introduction, History	Recall about basic thermodynamics and discuss about continuous development in the field of engines	Lecture Activity (Jigsaw)		Cross questioning in the class
2	Reciprocating internal combustion engines	Explain about the concept of reciprocating engines	Activity (Think Pair Share)	**[1606.1]**	In Class Quiz
3	Basic engine components-nomenclature	Organize and identify the components of engines	Activity (Reciprocal teaching)	**[1606.1]**	Home Assignment Class Quiz
4	Working principle of four stroke engines	Explain about the working phenomena of the 4-S engines	Lecture	**[1606.1]**	Home Assignment
5	Working principle of two stroke engines	Explain and discuss about the working phenomena of the 2-S engines	Lecture	**[1606.1]**	In Class Quiz
6	Engine cycles, Air standard cycles	Discuss and recall the basic cycles of thermodynamics	Activity (Think Pair Share)	**[1606.1]**	Home Assignment
7,8	Otto cycle	Design the working cycle of petrol engine based on thermodynamic cycles	Lecture, Flipped Class	**[1606.2]**	Home Assignment Class Quiz
9,10	Diesel cycle	Design the working cycle of diesel engine based on thermodynamic cycles	Lecture, Flipped Class	**[1606.2]**	Home Assignment Class Quiz
10,11	Dual cycle	Design the working cycle of diesel engine with dual energy input mode	Lecture, Flipped Class	**[1606.2]**	Home Assignment Class Quiz
12,13	**Testing & Performance:** Performance parameters	Compose the performance parameters	Lecture	**[1606.3]**	Class Quiz
14	Measurement of operating	Compose the operating	Lecture	**[1606.3]**	Class Quiz

	parameters e.g. speed, fuel & air consumption	parameters			
15,16	Powers, IHP, BHP, FHP, Efficiencies Thermal, Mechanical, Volumetric	Formulate the power and efficiencies generated by the engines	Lecture	**[1606.3]**	Class Quiz
17,18	Emission Measurement, Indian & International standards of Testing, Emission	Discuss about tail pipe emissions measurement and standards	Activity (Think Pair Share)		Home Assignment Class Quiz
19	**Fuels and its ratings** : Types of IC engine fuels	Identify the available fuels for I C engines	Lecture Activity (Jigsaw)		Class Quiz
20,21	Conventional Petroleum, structure, Refining Fuels for SI & CI engines	Analyse the petroleum extraction and refining process with structure analysis	Activity (Think Pair Share)		Home Assignment Class Quiz
22	Knock rating, Additives	Explain about rating of fuels and additives those changes the rating	Lecture		Class Quiz
23	Fuels for Turbine & Jet Propulsion	Discuss about the fuels of jet, etc.	Lecture		Class Quiz
24.25	**Alternative Fuels:** Methanol, Ethanol, Comparison with gasoline	Identify the alternates of fuels for I C engines	Lecture	**[1606.4]**	Class Quiz
26	**Engine combustion:** Ignition Limits	Explain about the limits of ignition	Lecture		Class Quiz
27,28	Stages of combustion, Combustion parameters. Delay period and Ignition Lag,	Discuss and identify the different stages of combustion and their dependency	Lecture, Flipped class	**[1606.5]**	Home Assignment Class Quiz
29.30	Turbulence and Swirl, Effects of engine variables on combustion parameters	Distinguish between induction pattern of fuel inside the chamber and variables affects the combustion	Lecture	**[1606.5]**	Class Quiz
31,32	Abnormal	Discuss about the	Lecture	**[1606.5]**	Class Quiz

	combustion in CI & SI engines, Detonation & knocking, Theories of detonation,	effects of abnormal combustion			
33,34	Control of abnormal combustion, Combustion chamber design principles, Types of combustion chamber.	Identify the variables through which control of abnormal combustion is possible, also design the chamber according to that	Lecture, Flipped Class	**[1606.5]**	Home Assignment Class Quiz
35	Basic introduction to combustion pre mixed and diffusion combustion	Explain pre mixed and diffused combustion	Lecture	**[1606.5]**	Class Quiz
36,37	**Engine Systems & Components:** Fuel System (SI Engine), Carburetion & Injection,	Distinguish between carburetion and injection	Lecture, Activity	**[1606.5]**	Class Quiz
38	Electronic injection systems, MPFI engines, CRDI engines	Discuss about the advanced injection systems	Flipped Class	**[1606.5]**	Home Assignment Class Quiz
39,40	Process & parameters, properties of A/F mixture, Requirements of A/F ratios as per different operating conditions,	Identify different conditions of air-fuel ratios	Lecture	**[1606.5]**	Class Quiz
41	**Ignition system:** Conventional & Modern ignition systems Magneto v/s Battery	Compare different ignition systems	Lecture	**[1606.5]**	Class Quiz
42	**Engine Friction, Lubrication & Cooling :** Determination of friction, Lubrication principles,	Discuss the friction in parts of engine and suitable lubricating principle	Lecture	**[1606.5]**	Class Quiz
43	Types of lubrication, Places of lubrication Bearings and piston rings etc.,	Distinguish the different lubrication systems	Lecture	**[1606.5]**	Class Quiz

44	Functions of Lubrication, Properties, Rating and Classification of lubricating oil,	Identify the way to improve the rating and properties of lubricating oil	Lecture	**[1606.5]**	Class Quiz
45	Additives, Lubrication systems. Engine Cooling: Requirements of cooling, Areas of heat flow,	Discuss the additives to improve the flow of heat in cooling	Flipped Class	**[1606.5]**	Home Assignment Class Quiz
46,47	High temperature regions of combustion chamber. Heat Balance, Cooling Systems, Air, Water Cooling, Cooling system components.	Identify and discuss the components of cooling system	Lecture	**[1606.5]**	Class Quiz
48,49	**Supercharging**: Objectives, Thermodynamic cycle & performance of super charged SI & CI engines, Methods of super charging, Limitations	Design and analyse the additional system for improving the performance of engine	Activity (Think Pair Share)	**[1606.6]**	Class Quiz
50,51	Two stroke engines: Comparison of 4s & 2s engines construction & valve lining scavenging. Process parameters, systems, supercharging of 2 stroke engines.	Discuss about scavenging and possibilities of supercharging in 2 stroke engine	Activity (Think Pair Share)	**[1606.6]**	Class Quiz
52	**Turbo-charging**	Explain about boosting the power of engine	Lecture Activity (Think Pair Share)	**[1606.6]**	Class Quiz
53,54	**Dual & Multi fuel engines**: Principle, fuels, Combustion, performance Advantages, Modification in fuel system	Compare the dual fuel, multi fuel and hybrid engines	Activity (Think Pair Share)	**[1606.6]**	Class Quiz

55	Modern developments in IC engines: Rotary (Wankel engine) combustion engine	Discuss the development in I C engines	Flipped Class	**[1606.6]**	Home Assignment Class Quiz
56	VCR engines	Design principal of advanced variable compression engine	Lecture Activity (Think Pair Share)	**[1606.6]**	Class Quiz

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
ME 1606.1	Compare the working of 4-S & 2-S for both SI & CI.	3														
ME 1606.2	Design the model of conventional I C engines.		2	3											3	
ME 1606.3	Solve & analyse the performance parameters of I C engines.		2		3											
ME 1606.4	Compare and categorize the alternate fuels in IC engines.				2			2								2
ME 1606.5	Analyse the process of different types of systems & components working together in I C engines.		2			2							2		2	
ME 1606.6	Develop some additional processes to advance the performance of I C engines for entrepreneurship skills.			2		3									3	

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering
Department of Mechanical Engineering
Course Hand-out
Metrology | ME 1607 | 3 Credits | 3 0 0 3
Session: Jan'19 – May'19 | Faculty: Dr D Mishra, Mr A Joshi and Mr GSS Adithya |
Class: B.Tech. Sem. VI

A. Introduction: This course is offered by Dept. of Mechanical Engineering for 6th Semester students, targeting students who wish to pursue research & development in industries or higher studies in field of Metrology, including study of various aspects of measuring instruments. Offers in-depth knowledge in Fits & gauges as well as various techniques by which the topography of a surface can be studied. Students are expected to have a background knowledge on basic measuring instruments for better learn.

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

[ME 1607.1] Identify the different measuring systems and standards employed in industry.

[ME 1607.2] Describe and differentiate various form errors on surface various mechanical components in industry.

[ME 1607.3] Identify the different types of fits of a several mating parts of an industrial component for skill improvement.

[ME 1607.4] Distinguish between various measurements instruments employed in a manufacturing industry.

[ME 1607.5] Describe and distinguish between various parameters of errors involved in threads and gears for skill development.

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 under- standing 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.

Program Specific Outcomes:

[PSO.1]. **Modelling & Analysis:** Model and analyse mechanical engineering components using advanced software
[PSO.2]. **Alternative fuels:** Analyse performance of I. C. engines attributed to alternate fuels
[PSO.3]. **Synthesis and Manufacturing:** Synthesize Advance Materials and Manufacture components and spares.

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, Presentations 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 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 participation by a student will be assessed and marks will be awarded.	

E. Syllabus:

Measurements & Measurement Systems: Measuring Standards. Static Characteristics of Instruments & measurement systems, Measurement of Pressure, Temperature, strain, force, torque and Shaft work. Limits, Fits and Tolerances: Interference and Transition fits, System of fits, Hole basis and Shaft basis. Gauges: Types of gauges & design. Measurement of Form Errors: Flatness, straightness and squareness measurement, Engineer's Square tester, Optical Square. Comparators, Principles, construction & working of mechanical & optical comparators. Screw Threads: Design principle and application. Surface Texture measurement: Methods of

measurement, Principles of design and operation. Gear measurement: Gear terminology, Errors in gears, Composite Tooth thickness, Gear tooth Vernier Callipers, Constant chord method, Base tangent method, Geometric Dimension & Tolerances.

F. Text Books:

T1. A.K. Bewoor & V. Kulkarni, Metrology & Measurement, McGraw Hill Publication, 2012.

G. References:

R1.. N.V. Raghavendra & L. Krishnamurty, *Engineering Metrology & Measurements*, Oxford Publications, 2013

R2. Thomas G. Beckwith, John H. Lienhard V, Roy D. Marangoni, Mechanical Measurements, Sixth Edition, Pearson Prentice Hall 2007.

H. Lecture Plan:
Metrology (ME 1607)

Lecture Number	Topic to be covered	Mode of delivery	Session Outcomes	Corresponding CO	Mode of assessing the outcome
L1	Introduction to Metrology	Chalk-Talk/PPT	Why Metrology and the importance of Mechanical Measurement	NA	NA
L2	Methods of measurement and errors in measurement	Chalk-Talk/PPT	Will be able to recall and reconceptualise of various method of measurement according to the standards	1607.1/ 1607.2	Brainstorm session
L3	Generalized Measurement System & its elements	Chalk-Talk/PPT	Categorize the measurement systems	1607.1	Quiz
L4	Static Characteristics of Instruments & measurement systems	Chalk-Talk/PPT	Recall the measurement systems and associated properties	1607.2	Quiz
L5 – L6	Measurement of Pressure	Chalk-Talk/PPT	Discuss the instruments used for measurement of pressure	1607.2	Quiz/ Test/ Assignment
L7 – L8	Measurement of Temperature	Chalk-Talk/PPT	Discuss the instruments used for measurement of Temperature	1607.2	Quiz/ Test/ Assignment
L9 – L10	Measurement of Strain	Chalk-Talk/PPT	Discuss the instruments used for measurement of Strain	1607.2	Quiz/ Test/ Assignment
L11 – L12	Measurement of Force, Torque & Shaft Power	Chalk-Talk/PPT	Discuss the instruments used for measurement of Temperature	1607.2	Quiz/ Test/ Assignment
L13	Introduction to Limits, Fits and Tolerances	Chalk-Talk/PPT	Understand the use of fits and assembly	1607.3	Test/Assignment
L14	Grades of Tolerance	Chalk-Talk/PPT	Understand and deliver the types of tolerances	1607.3	Quiz/Test/Assignment
L15	Types of fit & Hole basis and Shaft basis	Chalk-Talk/PPT	Understand and application of HBS and SBS	1607.3	Quiz/Test
L16-L19	Gauges: Types of gauges, construction,	Chalk-Talk/PPT	Will be able to understand and design the gauges	1607.3	Assignment

	design and application				
L20 – L22	Flatness measurement, straightness and Squareness measurement, Autocollimeter	Chalk-Talk	Describe the working and use of instruments	1607.4	Demonstration
L23 – L25	Indicator method, Engineer's Square tester, Optical Square, Simple numericals on Straightness	Chalk-Talk	Describe the working and use of instrument	1607.4	Demonstration
L26	Comparators: Introduction & types	Chalk-Talk/PPT	Describe the working and use of instruments	1607.4	Lab Demonstration
L27 – L28	Mechanical Comparators	Chalk-Talk/PPT	Describe the working and use of instruments	1607.4	Lab Demonstration
L29 – L30	Optical Comprators	Chalk-Talk	Describe the working and use of instruments	1607.4	Lab Demonstration
L31-L32	types of screw threads, principles of design and application	Chalk-Talk/PPT	Describe the working and use of instruments	1607.4	Lab Demonstration
L33- L36	Surface Texture measurement, Methods of measurement, Principles of design and operation	Chalk-Talk/PPT	Will be able to know the instrument used for measurement of roughness value – Theoretically and Practically	1607.4	Quiz/Test/ Assignment/ Demonstration
L37 – L38	Errors in gears, Composite Tooth thickness, Gear tooth Verneir callipers,	Chalk-Talk/PPT	Discuss the features associated with gear measurement	1607.5	Quiz/ Lab Demonstration

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES						
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
[ME 1607.1]	Identify the different measuring systems and standards employed in industry.	3	2	1	1	1								2		
[ME 1607.2]	Describe and differentiate various form errors on surface various mechanical components in industry.	3	1	2	1	1										1
[ME 1607.3]	Identify the different types of fits of a several mating parts of an industrial component for skill improvement.	2	2	1	1	2										1
[ME 1607.4]	Distinguish between various measurements instruments employed in a manufacturing industry.	3	2	2	2	1	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 Mechanical Engineering
Course Hand-out
Introduction to Micro Electro Mechanical Systems| ME 1654 | 3 Credits | 3 0 0 3
Session: Jan2019-May 2019 | Faculty: Ms. Priyanshu Sharma/B.Tech Sem. VI

A. Introduction: This course is offered by Dept. of Mechanical Engineering, targeting students who wish to widen their horizon in multi-disciplinary field of physics, material, mechanical and electronics. This course encourages students to mingle with the concepts of various subjects and to learn their applications at Micro scale running in present market. This course offers the understanding and structure design of devices like sensors, actuators, micro robots, which discusses there building science, fabrication and designing. The surface float of students with the course in various applications gives them an insight of its physics involved, working, fabrications and packaging.

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

[ME 1654.1]	Introduction of MEMS by historical developments, concept of miniaturization, advancement in MEMS from VLSI.
[ME 1654.2]	To understand design and fabrication concepts, technology- top-to-down and down-to-up, micromachining techniques for skill development.
[ME 1654.3]	To discuss micro-fabrications processes including wafer cleaning, oxidation and deposition methods based upon the material property
[ME 1654.4]	Understand application in the field of Electronics and building of micro-actuator, sensor, Metrology as well as micro-fluidics.
[ME 1654.5]	Case studies of micro-robots, micro-gyroscope, pressure sensor.

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.

PROGRAM SPECIFIC OUTCOMES

[PSO.1]. Modelling & Analysis: Model and analyze mechanical engineering components using advanced software.

[PSO.2]. Alternative fuels: Analyze performance of I. C. engines attributed to alternate fuels.

[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

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

Introduction to miniaturization, overview of micro-electromechanical systems, scaling analysis, sand to wafer, wafer level processing: RCA clean, Oxidation, Ion implantation, Physical vapor deposition, chemical vapor deposition, Epitaxy, sol-gel method, spin coating, Photolithography, Etching (Chemical and physical), Deep Reactive Ion Etching, Bulk micromachining, Surface Micromachining, LIGA, Process Modeling and case studies of process models of microcantilever, micro hinges, micro pressure sensors, transistors, gates, micro-robots, Microsensors: Pressure sensor, gyroscope, accelerometer etc. Microactuators: Electrostatic micro-comb drives, Piezoelectric, Shape Memory alloys etc. , Meterology, Microfluidics, Introduction to COMSOL, Modeling of MEMS using COMSOL, RF MEMS.

F. Text Book:

T1.G.K. Ananthsuresh et al ,'Micro and Smart Systems', Wiley, India, 2010.

G. Reference Books:

R1. Tai-Ran Hsu, MEMS and Micro systems Design and Manufacture, Tata McGraw Hill, 2002
R2.Nitaigour P. Mahalik, MEMS, Tata McGraw Hill, 2007
R3.Marc Madou, Fundamentals of Microfabrication, CRC Press, 2002.
R4.Chang Liu, Foundation of MEMS, Pearson Education Inc., NJ, 2006
R5. Nadim Maluf , An Introduction to Microelectromechanical Systems Engineering , Artech House, 2000.
R6.Gad- el-Hak, Introduction to MEMS, CRC Press, 2010

Lecture No.	Topic to be covered	Mode of delivery	Session Outcomes	Corresponding CO	Mode of assessing the outcome
L1-L2	**Introduction**: Need of MEMS, Historical developments, Advantages of miniaturization, Examples and their explanations, difference between VLSI and MEMS,	Chalk-Talk/PPT	MEMS need in market and difference between VLSI and MEMS principles	1654.1	NA
L3-L6	**Basic Concepts of MEMS Design and Fabrication**: Example of Dielectrophrosis, system on a chip, next generation MEMS, Top to Down technology, Micromachining- surface, bulk and LIGA (introduction), Material in MEMS	Chalk-Talk/PPT	Microfabrication methods will be learned and fabrication of few shapes will be learned.	1654.2	Quiz
L7-L9	**Scaling Laws:** Scaling in Geometry, Rigid body dynamics, Electrostatic forces, Paschen Effect, Electromagnetic forces, Fluid Mechanics and in Heat transfer	Chalk-Talk/PPT	Dominance pf physical forced will be analysed for various application.	1654.1	Quiz
L10-L13	**Microfabrication Processes I:** Sand to wafer, Chokralski method, Float Zone method, Polishing and finishing of wafer, Heat balance in CZ method.	Chalk-Talk/PPT	Microfabrication: Oxidation and reduction methods for wafer development will be learned	1654.3	NA
L14-L22	**Microfabrication Processes II:** Wafer level processing: RCA cleaning, Wafer identification, Silicon crystallography, Material in MEMS, Wafer level processing, oxidation(wet and dry), DG model, doping, ion implantation, thin film deposition, PVD, CVD, Epitxy, thick film deposition, lithography, itching, DRIE, Hstops, LIGA CASE STUDIES,	Chalk-Talk/PPT	Material and wafer level processing, lithography method and benefits will be learned and applications will be discussed.	1654.3	Assignment
L23-L27	**Electronics in MEMS**: diodes and transistors	Chalk-Talk/PPT	Basic replication of electronic element will be discussed.	1654.4	NA
L28-L33	**Microactuatars:** Electrostatic, piezoelectric, thermal(shape memory alloys) chemical **Microsensors:** Methods in mechanical microsensors, microaccelerometer, micropressure sensors , microgyroscope,	Chalk-Talk/PPT	Case studies will be discussed to learn the principle and fabrication of actuators and sensors.	1654.4, 1654.5	Assignment
L34-L37	**Meterology in MEMS:** Scanning electron microscopy, scanning tunnel microscopy, atomic force microscopy	Chalk-Talk/PPT	Measuring methods will be learned	1654.4, 1654.5	Assignment

L38-L40	**Microrobots:** Introduction, definition, classification, drive principles, peizo impact drive actuation, peizo and electromagnetic based actuation	Chalk-Talk/PPT	Basics of microrobot and working will be discussed.	1654.4, 1654.5	Assignment
L41-L42	**Microfluidics:** Definition, Advantages, Dimensionless numbers, Models, Micro fluidic pumping, Electrokinetic driven flows, electroosmosis, electrophoresis, Dielectrophrosis	Chalk-Talk/PPT	Type of flow, flow driving principles will be learned.	1654.4, 1654.5	Quiz

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

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ME 1654.1	Introduction of MEMS by historical developments, concept of miniaturization, advancement in MEMS from VLSI.	2		1	1											
ME 1654.2	To understand design and fabrication concepts, technology- top-to-down and down-to-up, Micromachining techniques for skill development.	1	2	2	2					1						
ME 1654.3	To discuss microfabrications processes including wafer cleaning, oxidation and deposition methods based upon the material property			2		2										
ME 1654.4	Understand application in the field of Electronics and building of	1	3	2				1								

	Microactuator, sensor, Metrology as well as Microfludics.																
ME 1654.5	Case studies of microrobots, microgyroscope, pressure sensor.				2			2		1		1					

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Mechanical
Engineering Course Hand-out

Tool Engineering| ME 1655| 3 Credits | 3 0 0 3

Session: Jan 19 – May 19 | Faculty: Dr. Anand Pandey | Class: B.Tech.Sem. VI

A. Introduction: This course is offered by Dept. of Mechanical Engineering for 6th Semester B Tech Mechanical Engineering students, who wish to pursue specialization course or higherstudies in the field of Machining & design/manufacturing of cutting tools or research & development in industries. It offers in depth knowledge of technical skills required by our students to become leaders in the field of production and operations management and related professions. This course provides the Machining viz. designing of cutting tools. It deals with industrial application of automotive and high strength alloys using tools.

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

[ME 1655.1]. Understand the concepts, scope and applications of tools materials & their geometry.

[ME 1655.2]. T o l e a r n t h e design-tool geometry of single and multiple point cutting tools in Machining.

[ME 1655.3]. To acquire and design the tools based on operations for skill development useful employability in manufacturing sector.

[**ME 1655.4].** Design and learn the various cutting tool and work holding devices.

[ME 1655.5] Different types of work holding devices.

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 under- standing 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.

PROGRAM SPECIFIC OUTCOMES-

[PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software
[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels
[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

C. Assessment Plan:

Criteria	Description	Ma
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) Quiz: Q1 on 01 Feb 2019 Q2 on 02 March 2019 Q3 on 07April 2019 Assignment: Two (2) Assignments to each students based on experimental study using	30 (Assignment and quiz carries 05 Marks each)

	A2 on 25 Feb 2019 (08 Mar 19) A3 on 25 Mar 2018 (08 Apr 19)	
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:

Fundamental of Tool design practice, procedure of tool design, Design of single point cutting tools such as solid tools , tipped tools, coated tipped tools, throw away type tools and diamond tools; design of milling cutters, gear milling cutters, hobs gear shaping tools, broaches, drills, reamers, taps & dies for thread cutting, boring tools, flat form tools, circular form tools. Essential requirements of jigs & fixtures, economics of jigs and fixtures, principles of location and clamping, location and clamping devices, types of drill bushes, types of jigs and fixtures- such as fixtures for milling, welding, heat treatment, grinding, assembly and inspection processes; standardization in jigs and fixtures, principle of work holders, common work holders for production like vice, chuck, arbor, mandrel & collet.

F. Text Books:

T1. C. Donaldson, G.H. Lecain, V.C. Goold, Tool Design, McGraw Hill Publication, 4th Edition 2013.
T2.N.K.Mehta, Metal Cutting and Design of Cutting Tools, Jigs & Fixtures. McGraw Hill Publication, 2015.

G. References:

R1. A.B. Chattopadhyay, Machining and Machine Tools, John Wiley Publication, 2015

H. Lecture Plan: Tool Engineering: (ME 1655)

Lec No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode Assessing
L1-2	Objectives and scope of Tool Engineering	Recall the objectives and applications of Tool Materials Management.	Lecture/Black Board	ME 1655.1	In Class Quiz (Not Accounted)
L3-4	Fundamental of Tool design practice	Recall the utility and importance of tools design	Lecture/Black board	ME 1655.1	In Class Quiz End Term
L5	Procedure of tool design, Design of single point cutting	Describe the tool geometry of single point cutting tool (Angles), applications and its manufacturing	Lecture/ppt	ME 1655.2	Home Assignment End Term
L6-7	Design concepts of solid tools, tipped tools, coated tipped tools,	Describe the detailed tool geometry and functions of solid tools, coated and tipped tools	Lecture/ppt	ME 1655.2	In Class Quiz End Term
L8-9	Design concepts of throw away type tools and diamond tools.	To learn the design and development of tools.	Lecture/ppt	ME 1655.2	Class Quiz Mid Term I End Term
L10-12	Design of milling cutters, gear milling cutters, hobs gear shaping	To design and learn the tool geometry of milling cutting tools.	Lecture/ppt	ME 1655.2	Class Quiz Mid Term I End term
L13	Types of broaches & design concepts	To learn the application and tool geometry of broaches.	Lecture/ppt	ME 1655.2	Home Assignment Class Quiz Mid

L14-15	Types of Drills & tool geometry	To learn the types of drills	Lecture/ppt	ME 1655.2	Class Quiz Mid Term
L16-17	Types of Reamers & tool geometry	Be able to understand the fundamentals of reamers	Lecture/ppt	ME 1655.3	Class Quiz Mid Term II End
L18-19	Types of taps & dies for thread cutting	To acquire the skills and knowledge of taps and dies	Lecture/ppt	ME 1655.3	Class Quiz End Term
L20-21	Types of boring tools and its design geometry	To know the about the boring applications and its design concepts.	Lecture/ppt	ME 1655.3	Class Quiz Mid Term II End Term
L22-23	Design-geometry of flat form tools, circular form tools.	To learn the technical details of form tools.	Lecture/ppt	ME 1655.3	Class Quiz
L24-25	Essential requirements of jigs & fixtures	To learn the concepts of design, setting and measuring datum surfaces.	Lecture/ppt	ME 1655.4	Mid Term II End Term
L26-27	Locating scheme, error analysis and elements of prismatic parts	To understand the designing concepts of Jigs and fixture.	Lecture/ppt	ME 1655.4	Class Quiz
L28-29	Economics of jigs and fixtures	To understand the economics of Jigs & fixture in Manufacturing	Lecture/ppt	ME 1655.4	Mid Term II End Term

L30-31	Principles of location and clamping	To know the fundamentals of clamping principles, method and elements	Lecture/ppt	ME 1655.4	Class Quiz
L32-33	Types of drill bushes.	To learn the types of drill bushes and their tool geometry.	Lecture/ppt	ME 1655.4	Mid Term II End Term
L34-35	Types of jigs and fixtures- such as fixtures for milling, welding, heat treatment, grinding, assembly and inspection processes;	To understand the basics, geometry, applications of types of jigs and fixtures.	Lecture/ppt	ME 1655.5	End Term
L36	Standardization in jigs and fixtures,	To acquire the concepts of Jigs for standardization	Lecture/ppt	ME 1655.5	End Term
L37-39	Principle of work holders, common work holders for production like vice, chuck, arbor, mandrel & collet.	To understand the concepts of design related to work holding devices.	Lecture/ppt	ME 1655.5	End Term

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

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO	2	3	4	5	6	7	8	9	10	11	1	PSO 1	PSO	PSO 3
[ME 1655.1]	Understand the concepts, scope and applications of tools materials & their geometry.	1		2												2
[ME 1655.2]	To learn the Design-tool geometry of single and multiple point cutting tools in Machining.	2		2												2
[ME 1655.3]	To acquire and design the tools based on operations for skill development useful employability in manufacturing sector.	1		3												2
[ME 1655.4]	Design and learn the various cutting tool and work holding devices.	1		3												1
[ME 1655.5]	Different types of work holding devices.	1		3												1

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering
Department of Mechanical Engineering
Course Hand-out
ALTERNATIVE FUELS AND ENERGY SYSTEM | ME 1656 | 3 Credits | 3 0 0 3
Session: Jan 19 – May 19 | Faculty: Vinoth R | Class: B. Tech. Semester VI

A. **Introduction:** This course is offered by Dept. of Mechanical Engineering for sixth semester students. This course offers a knowledge in different kind of alternative fuels for automotive applications. Year by year reduction of crude level as well as increasing pollution level is alarming for automobile engineers. This course is a complete stuff of different alternative fuels and alternative energy sources. Students are expected to have background knowledge on basic IC Engine and properties of gasoline, diesel etc.

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

[ME1656.1] Describe the effects of air pollution cause by transportation, on environment and also its effect on global warming.

[ME1656.2] Recall different properties of fuel to find suitability of it for IC engine used for different types of vehicles and availability of these alternative fuels for employability in automobiles sector.

[ME16.56.3]Examine different alternative sources with an analysis of formation of pollutants, engine performance and fuel efficiency.

[ME1656.4Examine different alternative fuels for IC engine with an analysis of formation of pollutants, engine performance and fuel efficiency.

[1656.5]Explain the working of hydrogen powered vehicle and also compare it with gasoline and diesel powered vehicle.

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

PROGRAM SPECIFIC OUTCOMES

[PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software
[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels
[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Open Book)	15
	Sessional Exam II (Open 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:

Introduction: Need, Availability, Suitability, Properties, Merits and Demerits of Potential alternative fuels and alternative energy sources. **Alcohols:** Properties as engine fuel, blends, neat form, performance characteristics, storage and safety precautions of Methanol, Ethanol, Diethyl ether and Dimethyl Ether. **Gaseous Fuels:** Suitability, modifications required to use in IC engines, performance characteristics, and storage and safety precautions of CNG, Hydrogen, LPG and Biogas. **Vegetable Oils:** Various vegetable oils for engines, esterification, performance characteristics, bio-diesel and its characteristics. **Hydrogen vehicle:** introduction and working

F. TEXT BOOK:

T1. S.S. Thipse “Alternative Fuels- Concepts, Technologies and Developments”, Jaico Publishing House, 2010.

G. REFERENCE BOOKS.

R1. A.S. Ramadhas, “Alternative Fuels for Transportation”, CRC Press, 2012.

R2. G D Rai, Non-conventional Energy Sources, Khanna Publications, 1997.

R3. S Rao and B B Parulekar, Energy Technology, Khanna Publishers, 2004.

R4. A W Culp, Principles of Energy Conversion, Mc Graw Hill International, 2001.

H. Lecture Plan:

Lec. No.	Topics	Session outcome	Mode of Delivery
1	Introduction and Course Hand-out briefing	To acquaint and clear teachers expectations and understand student expectations	Lecture
2,3	Introduction: Need of Alternative Fuels	Identify the need of alternative fuels	Lecture
3,4,5	Availability of Alternative Fuels	Explain the concept of system and illustrate examples for automotive control applications	Lecture
6,7,8	Suitability of Alternative Fuels and potential alternative energy sources	Suitability of different types of alternative Fuels for use in automobiles	Lecture
9,10,11	Properties of Alternative Fuels potential alternative energy sources	Explore the properties of alternative fuels and potential alternative energy sources	Lecture
12,13	Merits and Demerits of Potential alternative fuels	Comparison of different alternative fuels and their merits and demerits	Lecture
14 15,16,17 18,19	Alternative energy sources	EV and HEV: Electric vehicles and hybrid electric vehicles Fuel Cell: Basic of fuel cell and its potential over other alternative resources Merits and Demerits of Potential alternative energy sources: Comparison of different alternative energy sources and their merits and demerits	Lecture Flipped Classroom
20,21	Alcohols: Properties as engine fuel	Basic of alcohols and explore properties as engine fuel	Individual Activity
22,23	Alcohols blends	Different kind of alcohols blends and their comparison	Lecture
24	Alcohols neat form	Use of alcohols neat form as an automobile fuel	Lecture
25,26	Alcohols performance characteristics	Performance characteristics of different alcohols	Flipped Classroom
27	Storage and safety precautions of Methanol	Storage and safety precautions of Methanol and different issues related to it	Lecture, Activity
28	Storage and safety precautions of Ethanol	Storage and safety precautions of Ethanol and different issues related to it	Lecture
29	Storage and safety precautions of Diethyl ether and Dimethyl Ether	Storage and safety precautions of Diethyl ether and Dimethyl Ether and different issues related to it	Lecture
30,31,32	Gaseous Fuels: Suitability	Different types of Gaseous Fuels and their suitability for automobiles	Lecture
33,34,35	Gaseous Fuels: Modifications required to use in IC engines	Different types of gaseous Fuels and kind of modifications required to use them in IC engines	Lecture
36,37	Performance characteristics of Gaseous Fuels	Performance characteristics of Gaseous Fuels in comparison of gasoline and diesel	Lecture
38	Storage and safety precautions of CNG	Storage and safety precautions of CNG for transportation use	Lecture
39	Storage and safety precautions of Hydrogen	Storage and safety precautions of Hydrogen for transportation use	Lecture

40	Storage and safety precautions of LPG	Storage and safety precautions of LPG for transportation use	Lecture
41	Storage and safety precautions of Biogas	Storage and safety precautions of Biogas for transportation use	Lecture
42,43	Vegetable Oils: Various vegetable oils for engines	Explore various vegetable oils for engines and their comparison	Lecture
44,45	Esterification	Understand the process of esterification	Lecture
46,47	Performance characteristics of Vegetable Oils	Performance characteristics of Vegetable Oils	Lecture
48,49	Introduction of Bio-diesel	Basic of Bio-diesel and its properties	Lecture
50,51	Bio-diesel characteristics	Bio-diesel characteristics and comparison of it with diesel	Lecture
52,53	Introduction of Hydrogen vehicle	Case study of hydrogen vehicles and different components of this	Lecture
54,55	Working of Hydrogen powered vehicle	Explain the working of Hydrogen powered vehicle in comparison of gasoline powered vehicle	Lecture
56	Conclusion and Course Summarization	Conclude and Summarize Electronic Control for Vehicle System	Lecture

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

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
ME1656.1	Describe the effects of air pollution cause by transportation, on environment and also its effect on global warming.	1	1		1		2	3								
ME1656.2	Recall different properties of fuel to find suitability of it for IC engine used for different types of vehicles and availability of these alternative fuels for employability in automobiles sector.	2	1		1			2								
ME1656.3	Examine different alternative sources with an analysis of formation of pollutants, engine performance and fuel efficiency.	3	2		1			2						3		
ME1656.4	Examine different alternative fuels for IC engine with an analysis of formation of pollutants, engine performance and fuel efficiency.	3	2		1			2								
ME1656.5	Explain the working of hydrogen powered vehicle and also compare it with gasoline and diesel powered vehicle.	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 Mechanical Engineering

Course Hand-out

Advanced Manufacturing Techniques| ME 1657 | 3 Credits | 3 0 0 3

Session: Jan 2019 – May 2019. 1 | Faculty: Mr Ankur Srivastava & Mr Ashish Goyal | Class: B. Tech.Sem.VI

A. Introduction: This course is offered by Dept. of Mechanical Engineering for VI Semester students, targeting students who wish to pursue research & development in manufacturing industries or higher studies in field of Mechanical Engineering, including controlling of advanced manufacturing machines. Offers in-depth knowledge in Non -Traditional machines like AJM, EDM,WEDM, ECM, rapid prototyping etc. used in production in a manufacturing industry, Students are expected to have a background knowledge of manufacturing processes.

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

[ME 1657.1]. Identify the main elements of Manufacturing Processes like primary manufacturing processes and secondary manufacturing processes.

[ME 1657.2]. Demonstrate the knowledge of Non-Traditional Machining, Use of NTM machines in industries.

[ME 1657.3]. Describe the factors that are affect the performance of advanced manufacturing processes. And distinguish between the various parameters effecting the production in a manufacturing industry.

[ME 1657.4]. Define scope of advance manufacturing techniques in production industries for employability.

[ME 1657.5]. Describe casting and welding processes and applications in manufacturing 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 under- standing 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.

PROGRAM SPECIFIC OUTCOMES:

[PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software
[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels
[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

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:

Rapid Prototyping (RP): Introduction, Characteristics of RP Technologies, Subtractive and Additive Processes, Fused Deposition Modeling, Stereo lithography, laminated object manufacturing and three dimensional printing, applications of RP. Advanced Casting Processes: Metal mould casting, Continuous casting, Squeeze casting, vacuum mould casting, Evaporative pattern casting, Ceramic shell casting. Advanced Welding Processes: Electron beam welding (EBW), laser beam welding (LBW), ultrasonic welding (USW). Nontraditional Machining: Electrical discharge machining, Laser Beam Machining, Ultrasonic Machining, Electron beam machining, Abrasive jet machining, Water jet machining, Hybrid and Micro Machining Processes

F. Text Books:

T1.S. Kalpakjian, *Manufacturing Engineering and Technology*, Addison Wesley Longman, 4th Edition, 2002.

T2.A. Ghosh & A.K. Malik, *Manufacturing Science*, Affiliated East West Press Pvt. Ltd., 2nd Edition, 2010.

G. References:

R1.P.C. Pandey and H.S. Shan, *Modern Machining Processes*, McGraw Hill Publication, 1980.

H. Lecture Plan:

S.no.	Topics to be covered
L1	Introduction
L2,L3,L4	Rapid Prototyping (RP): Introduction, Characteristics of RP Technologies,
L5,L6,L7	Subtractive and Additive Processes, Fused Deposition Modelling
L8.L9	Stereo lithography, laminated object manufacturing
L10,L11	Three dimensional printing, applications of RP
L12,L13	Advanced Casting Processes: Metal mould casting
L14,15	Continuous casting, Squeeze casting
L16,L17	Vacuum mould casting, Evaporative pattern casting, Ceramic shell casting
L18	Advanced Welding Processes
L19,L20,L21	Electron beam welding (EBW), laser beam welding (LBW)
L22	Ultrasonic welding (USW).
L23	Non-traditional Machining:
L24,L25	Electrical discharge machining
L26, L27	Laser Beam Machining, Ultrasonic Machining,
L28,L29	Electron beam machining, Abrasive jet machining
L30,31,L32	Processing of plastics- Compression moulding, Injection Moulding, Blow Moulding
L33,L34	Water jet machining, Hybrid
L35,L36	Micro Machining Processes

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

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
[ME 1657.1]	Identify the main elements of Manufacturing Processes like primary manufacturing processes and secondary manufacturing processes.	3						3					2		1	
[ME 1657.2]	Demonstrate the knowledge of Non-Traditional Machining, Use of NTM machines in industries.	3	2		1	2	2	1						1		
[ME 1657.3]	Describe and distinguish between the various parameters effecting the production in a manufacturing industry.	3			1 2	2										
[ME 1657.4]	Describe scope of 2 advance manufacturing techniques in production industries for employability.							2								
[ME 1657.5]	Describe casting and welding processes and applications in manufacturing industries.			2							1				3	

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Mechanical Engineering
Course Hand-out

Production and Operations Management | ME 1658| 3 Credits | 3 0 0 3

Session: Jan 19 – May 19 | Faculty: Prof G L Sharma | Class: B.Tech. Semester VI

A. Introduction: This course is offered by Dept. of Mechanical Engineering for 6th Semester B Tech Mechanical Engineering students, who wish to pursue specialization course or higher studies in the field of Production and Operation Management or research & development in industries. It offers in depth knowledge of technical skills and intellectual discipline needed by our students to become leaders in the field of production and operations management and related professions. This course provides the comprehensive knowledge on fundamentals of management, detailed study of production planning, operations management, forecasting and methodology of layout planning. It deals with industrial application and basic of planning of any industry regarding its production and operations.

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

[ME 1658.1]. Understand the objectives, scope and functions of production and operations management.

[ME 1658.2]. Design and develop the new product or modify the existing products as per market requirements.

[ME 1658.3]. Analyse and evaluate the forecasting through understanding various qualitative and quantitative techniques.

[ME 1658.4]. Design the production planning, aggregate planning, master production schedule and production control for skills improvement in manufacturing industries.

[ME 1658.5] Different types of plant layouts and methodology to develop & design a layout.

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 under- standing 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.

PROGRAM SPECIFIC OUTCOMES:

[PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software

[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels

[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

D. Assessment Plan:

Criteria	Description	Maximum
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) Quiz: Q1 on 05 Feb 2019 Q2 on 09 March 2019 Q3 on 09 April 2019 Assignment: A1 on 25 Jan 2019 (04 Feb 19)	30 (Assignment and quiz carries 05 Marks each)

	A2 on 25 Feb 2019 (08 Mar 19) A3 on 25 Mar 2018 (08 Apr 19)	
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.	

I. Syllabus:

Introduction to production and operations management: Objectives, scope and functions of production management, planning, organizing, controlling in operations management. Production and process design: Needs for product design and development, product selection, modifying the existing products. Forecasting: Concept, basic elements, classification, purpose of sales forecasting, qualitative and quantitative techniques of forecasting. Production planning and control: Nature, types, elements, types of plans, strategy and aggregate production planning, master production schedule, production control. Plant location and layout: Types of layout, methodology of layout planning.

J. Text Books:

T1.S. N. Chary, Production and Operations Management, McGraw Hill Publication, 5e, 2017

T2.W. J. S. Irwin, Operation Management, McGraw Hill Publication, 9th Edition, 2005.

T3.S. Paton, B. Clegg, J. Hsuan, and A. Pilkington, Operations Management, McGraw Hill Publication, 2011

K. References:

R1.K. Aswathappa, S. Bhat, Production and Operations management, Himalaya Publication, 2nd Edition, 2015.

L. Lecture Plan: Production and Operations Management: (ME 1658)

Lec No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
L1-2	Objectives and scope of Production Management	Recall the objectives and various areas of Production Management.	Lecture	ME 1658.1	In Class Quiz (Not Accounted)
L3-4	Functions of Production Management	Recall the functions of Production Management	Lecture	ME 1658.1	In Class Quiz End Term
L5	Functions of Operations Management	Recall the functions of Operations Management.	Lecture	ME 1658.1	Home Assignment End Term
L6-7	Planning, organizing, controlling in operations management	Describe the detailed functions of operations management.	Lecture	ME 1658.1	In Class Quiz End Term
L8	Needs for product design and development	To acquaint the reasons for product design and development.	Lecture	ME 1658.2	Class Quiz Mid Term I End Term
L9	Product selection	Recall the factors considered in product selection.	Lecture	ME 1658.2	Class Quiz Mid Term I End term
L10	Modifying the existing products	Analyse the process of modifying existing products.	Lecture	ME 1658.2	Home Assignment Class Quiz Mid Term I End Term
L11	Concepts of Forecasting	To acquaint the need of forecasting and its meaning.	Lecture	ME 1658.3	Class Quiz Mid Term I End Term
L12	Basic elements of forecasting	Recall the various basic elements of forecasting.	Lecture	ME 1658.3	Class Quiz Mid Term I End Term
L13-14	Classifications of forecasting	Describe the detailed types of forecasting.	Lecture	ME 1658.3	Class Quiz End Term
L15	Purpose of sales forecasting	Recall the purpose of sales forecasting.	Lecture	ME 1658.3	Class Quiz Mid Term I End Term

L16	Qualitative and quantitative techniques of forecasting	Computing the forecasts through various techniques.	Lecture	ME 1658.3	Class Quiz Mid Term I End Term
L17	Time series methods	Computing forecasts through time series method.	Lecture	ME 1658.3	Class Quiz Mid Term I End Term
L18	Regression methods.	Computing forecasts through regression method.	Lecture	ME 1658.3	Class Quiz Mid Term I End Term
L19	Accuracy and control of forecasts.	Describe the accuracy of forecasts and how to control forecasts.	Lecture	ME 1658.3	Class Quiz End Term
L20-21	Production planning objective and functions	Describe the objectives and functions of production planning	Lecture	ME 1658.4	Class Quiz Mid Term II End Term
L22	Bill of material.	Preparing the BOM of particular case study.		ME 1658.4	Class Quiz Mid Term II End Term
L23	Capacity and man power requirement planning	Describe the need and methods of capacity and man power requirement planning.	Lecture	ME 1658.4	Class Quiz Mid Term II End Term
L24	Planning levels: long range, Intermediate range and Short range planning	Describe the various types of planning levels of an industry.	Lecture	ME 1658.4	Class Quiz Mid Term II End Term
L25	Objective, Strategies of Aggregate Planning	Describe the objectives and various strategies of aggregate planning.	Lecture	ME 1658.4	Class Quiz Mid Term II End term
L26	Graphical and mathematical techniques of aggregate planning	Demonstrate the various techniques of aggregate planning.	Lecture	ME 1658.4	Class Quiz
L27	Master production scheduling	Describe the basics of master production schedule & its preparation.	Lecture	ME 1658.4	Class Quiz Mid Term II End Term
L28	MRP and MRPII Systems	Demonstrate the MRP and MRPII systems.	Lecture	ME 1658.4	Class Quiz Mid Term II End Term
L29	Capacity control and priority control.	Describe the various factors considered I capacity and priority control.	Lecture	ME 1658.4	Class Quiz Mid Term II End Term
L30	Production control functions	Describe the necessity and functions of production control.	Lecture	ME 1658.4	Class Quiz End Term

L31	Routing, scheduling, dispatching, expediting and follow up	Describe the detailed functions of production control.	Lecture	ME 1658.4	Class Quiz End Term
L32-33	Techniques of production control in job shop production. Batch production and mass production systems.	Describe the various techniques of production control in various production systems.	Lecture	ME 1658.4	In Class Quiz End Term
L34-35	Types of Plant layout	Recall the types of plant layout	Lecture	ME 1658.5	Home Assignment End Term
L36	Methodology of Plant layout planning	Describe the various elements and methodology of layout planning	Lecture	ME 1658.5	In Class Quiz End Term
L37-38	Revision	Review of all the topics	Lecture	ME 1658.1-ME1658.5	
Quiz	Three Quiz to be conducted				

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

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
[ME 1658.1]	Understand the objectives, scope and functions of production and operations management.	1	0		2	1	1		1		1		1	1		
[ME 1658.2]	Design and develop the new product or modify the existing products as per market requirements.		1	3	2	3	1	1		2	1	2	1	1		
[ME 1658.3]	Analyse and evaluate the forecasting through understanding various qualitative and quantitative techniques.		3	2	2	1	2				2	1	1	1		
[ME 1658.4]	Design the production planning, aggregate planning, master production schedule and production control for skill improvement in industries.		1			1				1	2	2		1		
[ME 1658.5]	Understand the types of plant layouts and methodology to layout planning.	1	1	1	1	2				1	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 Mechanical Engineering
Course Hand-out
Heat Treatment | ME 1659 | 3 Credits | 3 000
Session: Jan 19 – May 19 | Faculty: Dr Saurabh Dewangan | Class: B.Tech. Sem. VI

A. Introduction: This course is offered by Dept. of Mechanical Engineering for VIth semester students of B. Tech, targeting students to learn the fundamental of physical, and mechanical properties of metallic and non-metallic alloys and how to improve the mechanical properties using variant methods of heat treatment methods. This course will help in any field that produces/manufacture and maintenance of automobile and mechanical components. The knowledge of heat treatments processes undergraduate engineers will be able to modify and tailor and properties to develop and review the different manufacturing processes and itsapplications.

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

[ME 1659.1]. Understand the basics of mechanical properties of alloys.

[ME 1659.2]. Analyze the mechanics of phase changes of alloys during heat treatments processes.

[ME 1659.3]. Understand various heat treatment methods and their applications for employability in industries.

[ME 1659.4]. Analyze the heating rate determination and characteristics of heat treating.

C. Program Outcomes and Program Specific Outcomes

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

[PO.2]. Problem Analysis: Identify, formulate, research literatureand analyzecomplex engineeringproblems 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 environmentalconsiderations.

[PO.4]. Conductinvestigationsofcomplexproblemsusingresearch-basedknowledgeandresearchmethods Including design of experiments,analysis andinterpretation of data and synthesis of information to provide valid conclusions**.**

[PO.5]. Modern Tool Usage: Create, selectand applyappropriatetechniques, resourcesandmodern engineering and IT tools including prediction and modelling to complex engineering activities with an under- standing of the limitations.

[PO.6]. TheEngineerand Society: Applyreasoninginformedbycontextualknowledgetoassesssocietal, 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 engineeringpractice**.**

[PO.9]. Individualand TeamWork: Functioneffectivelyasanindividual,and asa member or leader indiverse 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 designdocumentation,make effective presentations and giveand receive clearinstructions.

[PO.11]. Project Management and Finance: Demonstrate knowledge and understanding of engineering and managementprinciplesand apply theseto owners own work, as a memberand 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 technologicalchange.

PROGRAM SPECIFIC OUTCOMES:

[PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software

[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels

[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

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 mainta ined 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/ Activit y 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: Heat Treatment Processes: Annealing- its types and effect on mechanical properties, Normalizi ng, Hardening, Tempering, Surface hardening, Quenching. Chemical heat treatment of steels: Carburising and its types, post carburizing treatments, Cyaniding and Carbonitriding, Nitriding, Plasma nitriding, Boronizing & Chromizing, Hardenability. Elements of heat treatment process including heating rate determination and characteristics of heat treating furnaces, finishing operations, Heat treatment of tools, Heat treatment and application of Non-ferrous metals and alloys.

F. Text Books:

T1 T.V. Rajan, C.P. Sharma and A. Sharma, *Heat treatment principles and techniques*, Prentice Hall Publishers, 2nd Edition, 2010.

T2. W. Bolton, *Engineering materials technology*, Heinmann Newness, 3rd Edition, 2001.

G. References:

R1.B. Zakharov, *Heat treatment of Metals*, Mir Publishers, 1st Edition, 2002.

H. Lecture Plan:

Lecture Number	Topic to be covered	Assignment and Quiz test details
L1	Heat Treatment Processes	**Assignment -1 Quiz test-1**
L1	Heat Treatment Processes	
L2	Types of Engineering Alloys	
L3	Mechanical, Physical and chemical properties	
L4	Engineering Structures of alloys	
L5	Annealing- its types and effect on mechanical properties	
L6	Annealing- its types and effect on mechanical properties	
L7	Case study on annealing of mechanical component	
L8	Normalizing: Introduction and applications	**Assignment -2 Quiz test - 2**
L9	Normalizing: Mechanism and process	
L10	Hardening: : Introduction and applications	
L11	Hardening: Mechanism and process	
L12	Case study on hardening of mechanical parts	
L13	Tempering: Introduction and applications	
L14	Tempering: Mechanism and process	
L15	Case study on tempering of mechanical components	
L16	Surface hardening	
L17	Surface hardening	

L18	Quenching.	
L19	Quenching.	
L20	Chemical heat treatment of steels: Carburising and its types	**Assignment -3** **Quiz test - 3**
L21	Chemical heat treatment of steels: Carburising and its types	
L22	post carburizing treatments	
L23	Cyaniding and Carbonitriding	
L24	Cyaniding and Carbonitriding	
L25	Nitriding	
L26	Plasma nitriding	
L27	Hardenability	**Assignment -4** **Quiz test - 4**
L28	Elements of heat treatment process including heating rate determination and characteristics of heat treating furnaces	
L29	Heat treatment of tools	
L30	Heat treatment and application of Non-ferrous metals and alloys.	
L31	Chromizing	
L32	Boro-nizing	
L33	Case study -1	
L34	Case study-2	
L35	Case study 3	
L36	Case study -4	
L37	Case study -5	

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
[ME 1659.1]	Understand the basics of mechanical properties of alloys.	**1**				**1**										
[ME 1659.2]	Analyse the mechanics of phase changes of alloys during heat treatments processes.	**1**		**2**		**2**										
[ME 1659.3]	Understand various heat treatment methods and their Applications for employability in industries	**1**		**2**		**2**										
[ME 1659.4]	Analyse the heating rate determination and characteristics of heat treating.	**1**	**1**													

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering
Department of Mechanical Engineering
Course Hand-out
Automatic Control Engineering| ME1660 | 3 Credits | 3 0 0 3
Session: Jan 19 – May 19 | Faculty: Dr. Ajay Kumar | Class: B.Tech. Semester VI

A. Introduction: This course shall introduce the fundamentals of modeling and control of linear time invar iant systems; primarily from the classical viewpoint of Laplace transforms and a brief emphasis on the state space formulation as well. The course will be useful for students from major streams of engineering to build foundations of time/frequency analysis of systems as well as the feedback control of such systems.

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

[ME1660.1] Describe open and close loop systems and their practical implementation & find transfer functio n for different types systems.

[ME1660.2] Learn analogy between mechanical and electrical systems By getting mathematical modelling for different mechanical and electrical systems & get electrical equivalent circuit for mechanical systems using force voltage analogy and force current analogy for employability.

[ME1660.3] Reduce a complex systems by using block diagram reduction technique and signal flow graphs & analyse systems characteristics and get steady state and transient performance.

[ME1660.4] Check stability and relative stability using pole location and Routh hurwitch criteria.

[ME1660.5] Plot the system response using Bode plot, polar plot, Nyquist plot and root locus plot & analyse the system stability and relative stability using these plots.

[ME1660.6] Analyse multiple input multiple output systems using State Space analysis.

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.

PROGRAM SPECIFIC OUTCOMES

[PSO.1]. Modelling & Analysis: Model and analyze mechanical engineering components using advanced software.

[PSO.2]. Alternative fuels: Analyze performance of I. C. engines attributed to alternate fuels.

[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

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 (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 participatio n by a student will be assessed and marks will be awarded.	

E. SYLLABUS

Introduction: feedback control systems, concept of transfer function, block diagram representation of physica l systems, block diagram reduction technique, signal flow graph- Masons gain formula,

Derivations of time domain specifications for second order systems. Steady - State Errors: Classification of feedback control system according to type, static error coefficients- generalized steady state errors- steady state errors due to impulse, step, ramp and parabolic inputs,

Frequency Domain Analysis: Frequency domain specifications for second order systems, Correlation between frequency domain and time domain specifications,

Stability Analysis: BIBO stability, Location of roots of the characteristic equation, Routh Hurwitz criteria for absolute / relative stability. Root locus plots – construction of the root locus diagram- Interpretation of system response from these plots. Bode plots- gain margin and phase margin, Polar plots, Nyquist stability criterion, gain margin and phase margin,

System Compensation: Using elementary lag, lead and lead- lag compensating networks. Phase lead design using Bode diagram and root locus. Phase lag design using Bode diagram and root locus. Phase lag- lead design using Bode diagram and root locus. Pole Placement using Root locus.

F. TEXT BOOKS:

T1.K. Ogata, *Modern control engineering,* 5th edition, Prentice Hall India Publishers, Delhi.

T2. B. C. Kuo, F. Golnaraghi, *Automatic Control Systems*, 8th edition, Wiley Publishers, India, 2003.

G. REFERENCE BOOKS:

R1. R. C. Dorfand, R. H. Bishop, *Modern Control Systems*, 8th edition, Addison Wesley Longman Publicatio ns, 1998.

R2. J. D. Azzo John and H. Houpis Constantine, *Feedback control system analysis and synthesis*, McGraw Hill publications, New York, 2007.

H. LECTURE PLAN:

Lecture No.	Contents
1.	Basic concept on of control system: Control system definition, open loop and closed loop control systems, difference between them with examples, classification of control systems.
2.	Transfer function: Definition, general form of transfer function, poles and zeros of transfer function. of transfer function
3.	Mathematical modeling: Definition, translational system, rotational system, analogous system, force-voltage analogy, force-current analogy.
4.	Problem based on analogous system: F-V analogy and F-I analogy problems of both the translational and rotational systems. How to find the transfer function of mechanica l systems.
5.	Block diagram algebra: Definition, how to convert electrical systems into block diagram. Rules for block diagram reduction(BDR)
6.	Rules for block diagram reduction (BDR) continue, problems based on BDR.
7.	SFG: Definition, terminology, Mason's gain formula.
8.	Problems to be solved using Mason's gain formula
9.	How to convert a block diagram into SFG with problems, how to make SFG from system equations.
10.	How to convert differential equations into SFG with problems.
11.	More problems to be solved regarding BDR and SFG.
12.	Feedback theory: sensitivity of control systems to parameter variations with problem.
13.	Regenerative and degenerative feedback. Effect of degenerative feedback on control systems.
14.	Components of control system: AC Servomotor.
15.	Components of control system: DC Servomotor.
16.	Time domain analysis: Introduction to TDA. Standard test signals. Time response of 1st order systems to unit step and unit ramp inputs.
17.	Response of 2nd order system to unit step input

18.	Problems regarding TDA
19.	Problems regarding time response specification
20. 20.	Steady state error and error constants for different types of inputs with problems.
21. 21.	Generalized error series method with problems.
21.	Concept of stability: necessary conditions of stability, Hurwitz stability criteria, Routh stability criteria.
22. 22.	Routh-Hurwitz criteria with problems
23. 23.	Routh-Hurwitz criteria with problems (Continues)
24. 24.	Relative stability with problems
25.	Root locus: Concept of RL, angle and magnitude conditions.
26.	Rules to construct RL
27.	Rules to construct RL continue. Small examples can be taken to make understand the rules properly.
28.	Simple problems for RL
29.	More difficult problems for RL
30.	Root contour, effect of adding poles and zeros to root contour.
31.	Frequency domain analysis: Introduction, correlation between time and frequency response, advantages and disadvantages.
32.	Bode plot(Just the drawing of bode plot both the gain plot and phage plot)
33.	Bode plot with examples continues
34.	What is GCF, PCF, GM, PM, how to find from the bode plot.
35.	Determination of stability from Bode plot, how to study stability mathematically.
36.	Polar plot: Concept, advantages and disadvantages, how to sketch polar plot
37.	Nyquist plot, concept, conformal mapping (transfer function having no pole at origin) with problems.

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
ME1660.1	Describe open and close loop systems and their practical implementation & find transfer function for different types systems..	3							1							
ME1660.2	Learn analogy between mechanical and electrical systems By getting mathematical modelling for different mechanical and electrical systems & getelectrical equivalent circuit for mechanical systems using force voltage analogy and force current analogy for employability.		2	2								2				
ME1660.3	Reduce a complex systems by using block diagram reduction technique and signal flow graphs & analyse systems characteristics and get steady state and transient performance				2	2										
ME1660.4	Check stability and relative stability using pole location and Routh hurwitch criteria						2		2	3						
ME1660.5	Plot the system response using Bode plot, polar plot, Nyquist plot and root locus plot & analyse the system stability and relative stability using these plots.			1						1	1					
ME1660.6	Analyse multiple input multiple output systems using State Space analysis.															

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering
Department of Mechanical Engineering
Course Hand-out
REFRIGERATION AND AIR CONDITIONING| ME 1706 | 3 Credits | 3 0 0 3
Session: July 18 – Dec 18 | Faculty: Mr.Mayank Modak/B.Tech Semester VII

A. INTRODUCTION: This course is offered by Dept. of Mechanical Engineering, targeting students who wish to pursue research & development in industries or higher studies in field of Mechanical engineering. In this course we aimed to make the students familiar with the application of thermodynamics in the field of refrigeration and air conditioning. Further to explain the basic working and principle involved in refrigeration, air conditioning, refrigerants, Psychometry of air conditioning processes and to explain vapour compression and vapour absorption cycle systems.

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

[ME1706.1] Apply different laws and basic concept of refrigeration and air conditioning processes in daily life engineering applications for industrial employability.
[ME1706.2] Analyse the concept of vapour compression cycle systems and its application in air conditioning.
[ME1706.3] Analyse the concept of vapour absorption systems and its application in air conditioning.

[ME 1706.4] Analyse the various classes of refrigerants its compatibilities and selection methodology and concept of gas refrigeration cycle.

[ME 1706.5]Comprehend the basic definitions and terminology of psychrometry and air conditioning.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[P0.1] **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. PROGRAM SPECIFIC OUTCOMES

[PSO.1] Modelling & Analysis: Model and analyse mechanical engineering components using advanced software.

[PSO.2] Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels.

[PSO.3] Synthesis and Manufacturing: Synthesize advance materials for mechanical engineering applications**.**

E. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional quizzes and assignments	60 %
End Term Exam (Summative)	End semester examination	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.	

F. SYLLABUS

Basic refrigeration cycles: reverse Carnot cycle, effect of temperatures, Air refrigeration cycles, Bell - colemen cycle, Air refrigeration cycles for aircrafts; **Theoretical vapour compression cycle**: Compound vapour compression refrigeration system, Multi-evaporator and cascade systems, Ammonia Absorption refrigeration, Lithium Bromide Absorption system, Absorption versus compression systems, Refrigerants by class, CFC, HFC and HCFC refrigerant blends, comparison of thermodynamic properties of refrigerants, steam jet refrigeration; **Air Conditioning**: psychometric properties and charts, psychrometric of air- conditioning process, summer and winter air conditioning, calculation of heating and cooling loads, design of air conditioning systems, air-duct design, cold storage system.

Text Books:

T1. S.C.Arora and S.Domkondwar, *A Course in Refrigeration and Air conditioning*, Danpath Rai, New Delhi, 1996.

T2. Cook Norman, *Refrigeration and Air conditioning*, Macmillan London, 1989.

T3. W.F.Stocker, *Refrigeration and Air conditioning*, Tata McGraw Hill, 1985.

References:

R1.Prasad Manohar, *Refrigeration and Air conditioning*, New Age International, 2007

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	Refrigeration and Air conditioning – Introduction	Revision of Basic thermodynamics and Refrigeration	Lecture	ME 1706.1	In Class Quiz (Not Accounted)
3,	Introduction to Reversed carnot cycle	Recall the working principle of Reversed carnot cycle	Lecture	ME 1706.1	In Class Quiz End Term
4	Selection of operating temperature range of Reversed carnot cycle	Problem solving capabilities of students on Reversed carnot cycle	Lecture	ME 1706.1	Home Assignment End Term
5	Limitations of carnot cycle with gas as refrigerant	Understanding of problems associated with reversed carnot cycle in pacticle applications	Lecture	ME 1706.1	In Class Quiz End Term
6	Vapour compression cycle-Introduction	Understanding the basics of vapour compression refrigeration systems, modification of reversed carnot cycle with vapour as coolant	Lecture	ME 1706.2	Class Quiz Mid Term I End Term
7, 8	Ideal Vapour compression system	Understanding the concept of Ideal vapour compression system calculations	Lecture	ME 1706.2	Home Assignment Class Quiz Mid Term 1 End Term
9	Multi-stage vapour compression refrigeration systems	Problem solving capabilities of students on multi-stage vapour compression system	Lecture	ME 1706.2	Class Quiz Mid Term 1 End Term
10, 11	Cascade vapourcompression cycles	Understanding the system calculations on cascade vapour compression cycles	Lecture	ME 1706.2	Class Quiz Mid Term I End Term
12	Rating system of Vapour compression cycle	Understanding the concept of standard rating cycles and effect of various operating parameters on rating	Lecture	ME 1706.2	Class Quiz Mid Term II End Term
13	Vapour-Absorption systems-Introduction	Understanding the basics of Vapour -Absorption systems,	Lecture, Activity	ME 1706.3	Class Quiz Mid Term II End Term
14, 15	Simple vapour absorption systems	Understanding the system calculations on simple vapour absorption systems	Lecture, Activity	ME 1706.3	Class Quiz Mid Term II End Term
16, 17	Actual vapour absorption cycle	Understanding the basics of actual vapour	Lecture	ME 1706.3	Class Quiz Mid Term II

		absorption systems and its system calculation			End Term
18, 19	Ammonia absorption systems	Understanding the concept of Ammonia absorption systems and its system calculations	Lecture	ME 1706.3	Class Quiz End Term
20, 21	Lithium bromide absorption systems, single effect lithium bromide systems	Understanding the basics of Lithium bromide absorption systems and its system calculations	Lecture	ME 1706.3	Class Quiz End Term
22	Double effect Lithium bromide systems	Basics and system calculation on Double effect Lithium bromide systems	Lecture	ME 1706.3	Class Quiz End Term
23	Comparison of vapour compression and absorption cycles, new mixture for absorption systems	Understanding the relation between the Vapour compression and vapour absorption systems	Lecture	ME 1706.3	Class Quiz End Term
24	Gas cycle Refrigeration-Introduction	Understanding the basics of	Lecture	ME 1706.4	Class Quiz End Term
25, 26	Reversed Brayton (Bell coleman) cycle	Discussion on Reversed Brayton working principle, system calculations on Reversed Brayton cycle	Lecture	ME 1706.4	Class Quiz End term
27, 28	Air refrigaration cycles for aircrafts	Understanding the basics of air refrigeration cycles for aircrafts and simple aircraft refrigeration cycle with ram compression, problem solving capabilities of students on air refrigeration cycles for aircrafts	Lecture	ME 1706.4	Class Quiz
29	Refrigerants-Introduction	Discussion on class of Refrigerants, CFC, HFC and HCFC refrigerant blends	Lecture	ME 1706.4	Class Quiz End Term
30, 31	Designation of refrigerants, selection of refrigerants	Thermodynamic, chemical and physical requirements of refrigerants	Lecture	ME 1706.4	Class Quiz End Term
32	Basics of properties of Moist air, Gibbs Theorem, Dalton Law	Discussion on Gibbs theorem and Dalton law	Flipped Class	ME 1706.5	Class Quiz End Term
33	Psychrometric- Introduction	Discussion on Psychrometric properties and chart.		ME 1706.5	Class Quiz End Term
34	Dew point temperature and Wet Bulb temperature	Understanding the methodology for evaluation of Dew Point and Wet Bulb	Lecture	ME 1706.5	Class Quiz End Term

		Temperature from Psychrometric charts			
35	Air mixing Systems	Basic of adiabatic mixing of air, Assignments on Dew point and Wet bulb temperature for air mixing Systems and basic processes in air conditioning	Lecture	ME 1706.5	Class Quiz End Term
36	Summer and Winter air conditioning processes, Design methedology for air conditioning systems	Developments of problem solving capabilities of students on summer and Winter air conditioning processes	Lecture	ME 1706.5	Class Quiz End term
37	Conclusion and Course Summarization	NA	NA		Class Quiz

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

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
ME 1706.1	Apply different laws and basic concept of refrigeration processes in daily life engineering applications for industrial employability	2	2				2						2			
ME 1706.2	Analyse the concept of vapour compression cycle systems and its application in air conditioning.		2	2	2											
ME 1706.3	Analyse the concept of vapour absorption systems and its application in air conditioning.	2	2		1											
ME 1706.4	Analyse the various classes of refrigerants its compatibilities and selection methodology and concept of gas refrigeration cycle.		2		2			1								
ME 1706.5	Comprehend the basic definitions and			2		2										

	terminology of psychrometry and air conditioning.															

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering
Department of Mechanical Engineering
Course Hand-out
Mechanical Vibration | ME 1707 | 4 Credits | 3 1 0 4

Session: July18 – Dec 18 | Faculty: Prof. N.N. Sharma/Mr. Arpit Khandelwal/ Mr. Rakesh Kumar/B.Tech Sem.VII

A. Introduction: This course is offered by Dept. of Mechanical Engineering as compulsory for 7th semester students. This course is required to learn designing of mechanical systems and parameters those affect their working. It is also targeting students who wish to pursue research & development in industries or higher studies in field of mechanical system design. This course offers in depth knowledge of causes of vibration generation in different mechanical systems e.g. IC Engine, Turbines, compressors and other moving objects and also make student to learn how to prevent vibration in these systems. Students are expected to have background of mechanics and calculus.

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

[ME1707.1] Describe and identify causes and effects of vibration in mechanical systems
[ME1707.2] Construct linear vibratory models of different dynamic systems (e.g. linear and torsional) with different complexities like SDOF, MDOF
[ME1707.3]. Develop the differential equation of motion of vibratory systems using different approaches and solve the equations to get modes and mode shapes
[ME1707.4]. Analyse of free and forced (harmonic, periodic) vibration for single and multi-degree using different methods
[ME1707.5]. Develop skills for mathematical modelling of continuous system using MATLAB (e.g. string and rod)

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.

PROGRAM SPECIFIC OUTCOMES

[PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software.

[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels.

[PSO.3]. Synthesis and Manufacturing: Synthesize advance materials for mechanical engineering applications

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Open Book)	15
	Sessional Exam II (Open Book)	15
	Quizzes and Assignments and computer based test	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

Introduction to vibration, Longitudinal, Lateral and torsional vibration systems, Single degree of freedom, Free and forced Vibration: Equation of motion, Viscous and Coulomb damped vibration, whirling of shaft. Harmonic forced vibration, Rotary and reciprocating unbalance, Vibration isolation, Periodic and impulse vibration, Two degrees of freedom systems, Equation of motion using classical methods, Modal analysis using Eigen method, Vibration absorber. Multi degree freedom systems, Flexibility and stiffness matrices, Iterative methods: Holzer method, Matrix iteration, Rayleigh and Dunkerley's methods for modal analysis.Torsional vibration: Multi Degree of Freedom system, Geared system. Introduction to continuous systems.

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F. TEXT BOOKS

T1. S.S.Rao, Mechanical Vibration, Pearson Education, Delhi, 4th Edition

T2.G.K. Groover, Mechanical Vibration, Nem Chand & Bros, 8th edition

G. REFERENCE BOOKS

R1. W.T.Thomson, Theory of Vibrations with Applications, Chapman and Hall, 4th Edition, 1993

R2. J.D.Imnan, Engineering Vibration, Prentice Hall, New Delhi, 2001

R3. S. Graham Kelly, Mechanical Vibration: Theory and Application, Global Engineering.

H. 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: Definition of Degrees of Freedom with examples	Recall of Degree of freedom with examples	Flipped Classroom	1707.1	In Class Quiz (Not Accounted)
3	Analysis using Newton's classical method and energy method	Understanding of Newton's classical method and energy method	Lecture	1707.1	In Class Quiz End Term, Mid term 1, Mid term 2
4	Introduction to Longitudinal,Lateral and Torsional systems (undamped free vibration)	Explain types of vibration	Lecture	1707.1	Home Assignment End Term
5	Effect of spring mass on natural frequency and Springs in series and parallel	Arrangement of springs	Lecture	1707.2	In Class Quiz End Term
6	Problems based on vibration of lever	Able to make governing equations	Flipped Class	1707.2	Class Quiz Mid Term I End Term
7	Problems based on vibration of pulley	Able to make governing equations and natural frequency	Flipped Class	1707.2	Class Quiz Mid Term I End term
8-11	Other miscellaneous problems	practice for forming of governing equations for various system	Flipped Class	1707.2	Home Assignment Class Quiz Mid Term I End Term
12	Damped free vibration	Understanding of effect of damping on vibration	Activity (Think Pair Share)	1707.2	Class Quiz Mid Term I End Term
13	Over damped and critical damped systems	Develop understanding of various types of damped system and able to differentiate them	Lecture	1707.2	Class Quiz Mid Term I End Term
14	Under damped systems and logarithmic decrement	Able to determine the response of underdamped system	Lecture	1707.2	Class Quiz End Term

15-16	Problems based on damped free vibration	Able to apply the concepts to real life problems	Lecture	1707.4	Class Quiz Mid Term II End Term
17	Forced vibration (periodic and Aperiodic)	Explain difference between free and forced vibration	Lecture, Activity	1707.4	Class Quiz Mid Term II End Term
18	Forcing due to unbalance	Describe the nature of vibration due to rotating and reciprocating unbalance	Lecture, Activity	1707.4	Class Quiz Mid Term II End Term
19	Forcing due to support motion	Understanding of effect of motion transmissibility	Lecture	1707.4	Class Quiz Mid Term II End Term
20	Vibration Isolation and transmissibility	Understanding of isolation and force transmissibility	Lecture	1707.4	Class Quiz End Term
21-23	Problems based on forced vibration	Able to apply concepts to the problems	Flipped Class	1707.4	Class Quiz End Term
24-26	Natural frequency and modes of vibration using classical method	Understanding of modes of vibration	Flipped Class	1707.4	Class Quiz End Term
27-29	Problems on two DOF systems	Able to apply Lagrange's method and Newton's method to determine frequencies and mode shapes	Flipped Class	1707.4	Class Quiz End Term
30	Dynamic vibration absorber	Explain general about absorbers and their application	Flipped Class	1707.5	Class Quiz End Term
31	Centrifugal pendulum absorber	Able to understand between various pendulum	Flipped Class	1707.5	Class Quiz End term
32-33	Influence coefficient method for MDOF	Explain about influence coefficients and their importance	Flipped Class	1707.5	Class Quiz
34	Natural frequency and mode shape (Eigen Values and Eigen Vectors)	Explain concepts of Eigen value method to determine natural frequencies	Lecture	1707.5	Class Quiz Mid Term II End Term
35-36	Problems based on MDOF	Apply concepts of Eigen value method to plot mode shapes	Flipped Classroom	1707.5 1707.3	Class Quiz Mid Term II End Term

37	Torsional vibration (Single Rotor and Two rotor system)	Explain torsional vibration and why it happens	Flipped Classroom	1707.5 1707.3	Class Quiz End Term
38	Torsionally equivalent shaft and torsional vibration of geared system	Describe how to make equivalent system	Flipped Classroom	1707.5 1707.3	Class Quiz End Term
39	Problems based on torsional vibration	Determine of natural frequencies and mode shapes for SDOF and Two DoF	Lecture	1707.1	Class Quiz End Term
40	Torsional vibration of three rotor system	Describe 3 DOF rotor system	Flipped Classroom	1707.1	Class Quiz End Term
41-42	Holzer's method for multi rotor system	Explain Holzer's method and its usefulness in find out natural frequencies for torsional ssytem	Flipped Classroom	1707.1	Class Quiz End Term
43	Problems based on multi rotor system	Able to apply Holzer's method	Flipped Classroom	1707.1	Class Quiz End Term
44	Matrix iteration method	Explain Matrix iteration Method to solve MDOF system	Lecture	1707.4	End Term
45	Problems based on matrix iteration method	Apply Matrix Iteration method to find response of MDOF	Lab Sessions	1707.4	End Term Theory
46	Rayleigh's method for lumped mass system	Difference between lumped and continuous mass system and explain Rayleigh's method	Lecture	1707.5	End Term
47	Rayleigh's method for distributed mass system	Explain various distributed mass system	Lecture	1707.5	Class Quiz End Term
48	Problems based on Rayleigh's Method	Able to apply Rayleigh's method	Lecture	1707.5	Class Quiz End Term
49	Dunkerley's method	Explain Dunkerley's method for Transverse Vibration	Lecture	1707.5	Class Quiz End Term
50	Problems based on Dunkerley's method	Apply Dunkerley's method	Lecture	1707.5	Class Quiz End Term
51	Whirling of shafts	Explain phenomena of whirling of shaft	Lecture	1707.5	Class Quiz End Term
52	Problems based on whirling of shafts	Determination of critical speed of shaft to avoid resonance	Lecture	1707.5	Class Quiz End Term

53	Transverse vibration of a string or cable	Explain formulation of governing equation of string or cable	Lecture	1707.5	Class Quiz End Term
54-57	Longitudinal vibration of bar or rod	Explain formulation of governing equation of bar or rod	Lecture	1707.5	Class Quiz End Term

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

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
ME 1707.1	Describe and identify causes and effects of vibration in mechanical systems		1													1
ME 1707.2	Construct linear vibratory models of different dynamic systems (e.g. linear and torsional) with different complexities like SDOF, MDOF	3	2											2		
ME 1707.3	Develop the differential equation of motion of vibratory systems using different approaches and solve the equations to get modes and mode shapes	3														
ME 1707.4	Analyse of free and forced (harmonic, periodic) vibration for single and multi-degree using different methods				2	1								3		
ME 1707.5	Develop skills for mathematical modelling of continuous system using MATLAB (e.g. string and rod)	3														

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Mechanical Engineering

Course Hand-out

Computer Integrated Manufacturing | ME 1708 | 3 Credits | 3 0 0 3

Session: July 18 – Dec 18 | Faculty: Prof. A.K.Sharma, Mr Shyam Sundar Sharma; | Class: B. Tech. Sem.VII

A.Introduction: This course is offered by Dept. of Mechanical Engineering for 7th Semester students, targeting students who wish to pursue research & development in industries or higher studies in field of Mechanical Engineering, including controlling of advanced machine tools. Offers in-depth knowledge in CNC machines, and other parameters effect the production in a manufacturing industry, Students are expected to have a background knowledge on basic machine tools for better learning.

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

[ME 1708.1]. Identify the main elements in computer integrated manufacturing systems;

[ME 1708.2]. Demonstrate the knowledge of computer numerical control (CNC) and CNC programming, use commercial CAD/CAM software to process product models & demonstrate the knowledge of the operation of CNC machines for employability.

[ME 1708.3]. Describe and distinguish between the various parameters effecting the production in a manufacturing industry.

[ME1708.4]. Describe scope of group technology in fabrication industry & Prepare CAPP (Computer Aided Process Planning) for fabrication process equipment.

[ME 1708.5]. Describe FMS (Flexible manufacturing System) in welding shop & understand the integration of computers with the various sections of a manufacturing industry.

A. 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 under - standing 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.

PROGRAM SPECIFIC OUTCOMES:

[PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software
[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels
[PSO.3]. Synthesis and Manufacturing: Synthesize Advance Materials and Manufacture components and spares.

C. 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 (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:

Development in Machine Tools, Components of NC Machine, Problem with conventional NC. CNC Machine, Classification, Advantages and disadvantages of CNC machine, Design consideration of CNC Machines, Methods of improving machine accuracy and productivity; Programming of CNC, Co-ordinate measuring machines. Introductio n to Robotics, Robot anatomy physical configurations, Types of Manufacturing System, Machine Tools and related equipment, Material Handling System, Computer control in CIM, Human Labour in CIM, benefits of CIM, Computer Aided Process planning, Computer integrated planning systems, Material requirement planning. Capacity planning, Shop Floor Control, Factory Data Collection Systems, Automatic Identification Systems - Bar Code Technology, Automated Data Collection Systems

F. Text Books:

1. K.Yoram, Computer Control of Manufacturing Systems and Computer Integrated Manufacturing, McGraw Hill, Singapore, 1983.
2. P.G.Mikell, Automation, Production Systems, and computer Integrated manufacturing" Prentice Hall of India, New Delhi, 2003.

G. References:

1. K.Yoram and Ben and Uri Joseph, Numerical Control of Machine Tools, Khanna Publishers, New Delhi, 2005.
2. P.Radhakrishnan, Computer Numerical Control Machines, New Central Book Agency (P) Ltd.,Kolkata, 2004.
3. HMT Limited, Mechatronics, Tata McGraw Hill Publishing Co. Ltd., New Delhi 1998.

H. Lecture Plan:

Computer Integrated Manufacturing: (ME 1703)

Lecture	Topic	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
L1	Introduction to the Computer Integrated Manufacturing	To acquaint and clear teachers expectations and understand student expectations	Lecture/PPT	**[1708.1]**	NA
L2	Development in Machine Tools	Students will understand the importance of 'Machining & types of Machine Tools	Lecture/PPT	**[1708.1]**	Mid-Term 1 Quiz
L3	Components of NC Machine	Students will be able to understand fundamental of NC Components & their functions	Lecture/PPT	**[1708.1]**	Quiz
L4	Advantages & Disadvantages of NC machine	Student will be able to understand the applicatio ns and limitations of NC	Lecture/PPT	**[1708.1]**	Mid-Term 1 Quiz

L5	Major Problems with Conventional NC Machine	Problem Solving	Lecture/PPT	**[1708.1]**	Assignment
L6	CNC machine and its Functions	Discuss different types of working functions of CNC machine tools	Lecture/PPT	**[1708.2]**	Mid-Term 1 Quiz End term Exam
L7	CNC machine and its Functions (Cont.)	Understand in detail about functions of its parts/components	Lecture/PPT	**[1708.2]**	Mid-Term 1 End term Exam
L8	Detail Functions of CNC (Cont.)	Understand in detail about functions of its parts/components	Lecture/PPT	**[1708.2]**	Quiz End term Exam
L9	DNC machine and its functions	Able to understand the DNC	Lecture/PPT	**[1708.2]**	Mid-Term 1 End term Exam
L10	Types of DNC & Classification of CNC Machines	Students will understand about types of DNC Machine Tools	Lecture/PPT	**[1708.2]**	Quiz End term Exam
L11	Advantages and disadvantages of CNC machines	Student will be able to understand the applicatio ns and limitations of CNC	Lecture/PPT	**[1708.2]**	Mid-Term 1 Quiz End term Exam
L12	Programming of CNC - Introduction	Able to learn the basic of CNC Programming	Lecture/PPT	**[1708.2]**	Mid-Term 1 Quiz End term Exam
L13	Programming of CNC - APT language	Describe to APT language	Lecture/PPT	**[1708.2]**	Mid-Term 1 Quiz End term Exam
L14	Coding of CNC Drilling	Understand the concepts of coding in CNC	Lecture/PPT	**[1708.2]**	Mid-Term 1 Quiz End term Exam
L15	Coding of CNC	Drilling (Cont.)	Understan	d the	concepts of

L16	Coding of CNC Milling	Understand the concepts of coding in CNC (Milling)	Lecture/PPT	**[1708.2]**	Mid-Term 1 Quiz End term Exam
L17	Coding of CNC Milling (Cont.)	Learn about overall concepts of coding in CNC (Milling)	Lecture/PPT	**[1708.2]**	Quiz End term Exam
L18	Introduction to Robotics	Describe various systems /parts of robotics	Lecture/PPT	**[1708.3]**	Quiz & Assignment End term Exam
L19	Robot anatomy & Physical configurations	Understand importance of robot and types of robot configurations	Lecture/PPT	**[1708.3]**	Mid-Term 2 End term Exam
L20	Robotic Sensors and grippers classification	Learn about robotic sensors	Lecture/PPT	**[1708.3]**	Mid-Term 2 End term Exam
L21	Introduction to Computer Integrated Manufacturing Systems	Learn about fundamenta ls of CIM	Lecture/PPT	**[1708.3]**	Quiz End term Exam
L22	Components of CIMS	Students will enhance the knowledge of CIM	Lecture/PPT	**[1708.4]**	Mid-Term 2 End term Exam
L23	Introduction to Group Technology	Understand various features of GT	Lecture/PPT	**[1708.4]**	Mid-Term 2 End term Exam
L24	Types of GT	Understand various types of GT	Lecture/PPT	**[1708.4]**	Mid-Term 2 End term Exam
L25	Advantage & disadvantage of GT	Learn about advantages and limitations of GT	Lecture/PPT	**[1708.4]**	Assignment & Discussion End term Exam
L26	Computer aided Process Planning	Learn about CAPP	Lecture/PPT	**[1708.4]**	Mid-Term 2 Quiz

L27	Types of CAPP	Learn applications and types of CAPP	Lecture/PPT	**[1708.4]**	Mid-Term 2 End term Exam
L28	Types of CAPP (Cont.)	Describe various CAPP tools	Lecture/PPT	**[1708.4]**	Mid-Term 2 Quiz End term Exam
L29	Computer Integrated Production Planning systems	Understand importance of CIPPS	Lecture/PPT	**[1708.4]**	Quiz End term Exam
L30	Classification of CIPP	Describe various CIPP	Lecture/PPT	**[1708.4]**	Assignment & Discussion End term Exam
L31	Material Requirement Planning (MRP)	Identify the need of MRP	Lecture/PPT	**[1708.5]**	Mid-Term 2 Quiz End term Exam
L32	Inventory Planning	Identify the basic need of inventory in factory	Lecture/PPT	**[1708.5]**	Mid-Term 2 Quiz End term Exam
L33	Types of MRP	Learn types of MRP	Lecture/PPT	**[1708.5]**	Mid-Term Quiz End term Exam
L34	Introduction of Capacity Planning	Understand the concepts of Capacity planning.	Lecture/PPT	**[1708.5]**	Mid-Term 2 End term Exam
L35	Shop Floor Control	Identify and discuss application areas of shop floor in factory.	Lecture/PPT	**[1708.5]**	Mid-Term 2 Quiz End term Exam
L36	Factory Data Collection Systems	Identify and discuss application areas of FDCS	Lecture/PPT	**[1708.5]**	Mid-Term 2 End term Exam

L37	Automatic Identification Systems	Identify and discuss applications of automatic systems.	Lecture/PPT	**[1708.5]**	Mid-Term 2 Quiz End term Exam
L38	Bar code technology & automated data collection systems	Identify and discuss bad codes.	Lecture/PPT	**[1708.5]**	Mid-Term 2 End term Exam
L39	Revision	QUIZ	Lecture/PPT	**[1708.5]**	Mid-Term 2
L40	Revision	QUIZ	Lecture/PPT		Quiz

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

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
[ME 1708.1]	Identify the main elements in computer integrated manufacturing systems;	3						3					2		1	
[ME 1708.2]	Demonstrate the knowledge of computer numerical control (CNC) and CNC programming, Use commercial CAD/CAM software to process product models & demonstrate the knowledge of the operation of CNC machines for employability.	3	2		1	2	2	1						1		
[ME 1708.3]	Describe and distinguish between the various parameters effecting the production in a manufacturing industry.	3			1	2	2								2	
[ME 1708.4]	Describe scope of group technology in fabrication industry & Prepare CAPP (Computer Aided Process Planning) for	2						2								

	fabrication process equipment															

[ME 1708.5]	Describe FMS (Flexible manufacturing System) in welding shop & understand the integration of computers with the various sections of a manufacturing industry			2							1					

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering
Department of Mechanical Engineering
Course Hand-out
Computer Aided Design| ME 1709 | 3 Credits | 3 0 0 3
Session: Jul 18 – Dec 18 | Faculty: Mr. Arpit Khandelwal/ Dr. Santosh Patil/ Dr. R K Gupta| Class: B.Tech Sem. VII

A. Introduction: Computer aided design is widely used in industry for analysing and modelling structures and creating solutions for various problems at a faster and efficient ways. CAD is particularly useful for engineer ing designs that are too complicated to be solved by conventional designing process. The brief contents of the course include Introduction to CAD, Cad tools, Hardware and software for CAD, mathematical representation of curves, surface and solids, synthetic surfaces, solid modelling.

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

[ME1709.1] Describe the design process and basic CAD **skills** for engineering design and drawing [1709.2] Evaluate the CAD transformations and curve fitting
[ME1709.3] Illustrate the core concepts of computer graphics
[ME1709.4] Represent parametric cubic, Bezier, B-spline curves and surfaces and solids
[ME1709.5] Possess a good understanding of solid modelling for employability in design of components.

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 under - standing 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.

PROGRAM SPECIFIC OUTCOMES:

[PSO.1]. **Modelling & Analysis**: Model and analyse mechanical engineering components using advanced software
[PSO.2]. Alternative fuels: Analyse performance of I. C. engines attributed to alternate fuels
[PSO.3]. **Synthesis and Manufacturing**: Synthesize Advance Materials and Manufacture components and spares.

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 (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

Introduction to CAD, Geometric transformation techniques, Representation of curves, curve fitting techniques, Cubic curves, Beziers and b-splines, Hermite curve, Rational curves\NURBS. Types and representation of surfaces, Analytic surfaces, Synthetic types, Polygon surfaces, Quadric and super quadric surface, Bezier and B-spline surface, Hermite surface, Coon's surface, Blobby objects. Solid Modeling: Constructive solid geometry, Boundary representation, CAD standards, Graphical kernel system (GKS), Data exchange standards for modelling data

K. Text Books

T1. I.K. Zeid, CAD/CAM Theory and Practice, Tata McGraw Hill New Delhi, 1998.

T2. D.F.Rogers and J Alan Adams, Mathematical Elements for Computer Graphics, Tata McGraw Hill New Delhi, 2002.

L. Reference Books

R1. D.F.Rogers and J A Adams, Procedural Elements for Computer Graphics, McGraw

M. Lecture Plan:

Lec No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
L1–L2	Introduction to CAD, benefits and application	To understand the basics of Computer Aided Design and product life cycle	Lecture	1709.1	In Class Quiz (Not Accounted)
L3	Conventional and CAD comparisons	Debate on the conventional and CAD practices	Flipped Classroom	1709.1	In Class Quiz
L4	Data Exchange in Cad	Comparison about the various data exchange types in cad	Lecture	1709.1	In Class Quiz Mid Term I End Term
L5 – L7	Geometric transformation techniques, translation, rotation, scaling	Explain different transformation procedures and formulations	Lecture	1709.2	Home Assignment Mid Term I End Term
L8	Problems based on translation, rotation and scaling, Quiz 1	Employ translation , rotation and scaling transformations and solve	Lecture	1709.2	In Class Quiz End Term
L9	Reflection and shearing,	Employ reflection and shearing transformations and solve	Lecture	1709.2	Class Quiz Mid Term I End Term
L10–L11	Problem based on 2D and 3D transformation technique	Employ different transformations and solve	Self-Study	1709.2	Home Assignment Class Quiz Mid Term I End term
L12	Problem based on 2D and 3D transformation technique continued.	Employ different transformations and solve	Self-Study	1709.2	Class Quiz Mid Term I End Term
L13	Quiz 2 and Assignment – 1 and 2	Recall the CAD basics and solve transformation problems	Quiz	1709.1 1709.2	Class Quiz Mid Term I End Term
L14–L15	Curve Fitting- Polynomial approximation and Problems	Describe the Curve fitting techniques	Lecture	1709.3	Class Quiz Mid Term I End Term
L16–L17	Method of Least Squares and Problems	Describe least square curve fitting method and employ it	Lecture	1709.3	Class Quiz End Term
L18	Matrix Formulation of Least Square Methods and Problems	Employ least square method and matrix formulation	Lecture, solving problems	1709.3	Home Assignment Class Quiz Mid Term I End Term
L19	Weighted Least Square Method	Describe other different least square curve fitting techniques	Lecture, solving problems	1709.3	Class Quiz Mid Term I End Term

L20 –L2	Exponential function curve fitting and Parametric representation of synthetic curves- Blending functions	Describe exponential curve fitting techniques and curve representation	Lecture	1709.2 1709.3	Class Quiz Mid Term II End Term
L23 –L2	Cubic spline, Bezier and B-spline Curves and Problems	Describe curve representation forms and formulations	Lecture	1709.4	Home Assignment Class Quiz Mid Term II End Term
L25	Quiz 3 and Assignment – 3 and 4	Recall the curve fitting and curve representation techniques	Quiz	1709.4	Class Quiz
L26 –L2	Hermite curves, Comparison between all types of curves	Compare different types of curve representation forms	Flipped Class	1709.4	Class Quiz Mid Term II End Term
L28	Curve manipulation – Design and application	Describe curve formulation and manipulation	Flipped Class	1709.4	Class Quiz End Term
L29 –L3	Representation of 3D graphics surfaces and Super quadric surfaces	Describe surface representation forms and formulations	Flipped Class	1709.3	Home Assignment Class Quiz Mid Term II End Term
L31– L3	Bezier, B-spline Surfaces, Hermite Surfaces	Describe surface representation forms and formulations	Flipped Class	1709.4	Home Assignment Class Quiz Mid Term II End Term
L33	Quiz 4 and Assignment – 5 and 6	Recall the surface representation techniques	Quiz	1709.3 1709.4	Class Quiz End term
L34 –L3	Offset, Plane and Ruled surfaces	Describe the measurement of PM and NOx in engines	Flipped Class	1709.4	Class Quiz Mid Term II
L36	Tabulated cylinder and rational parametric surface	Identify different alternative fuels and analyse the ability of a specimen to be a fuel based on its properties	Lecture	1709.4	Class Quiz End Term
L37	COON's surface and surface manipulation	Examine fuel properties, sketch and compare emission trends in engines	Flipped Classroom	1709.4	Class Quiz End Term
L38 –L3	Representation of Solid model and entities, B-rep and CSG	Examine fuel properties, sketch and compare emission trends in engines	Flipped Classroom	1709.5	Class Quiz End Term
L40 –L4	Sweep representation and analytical solid modelling and Feature based modelling, Quiz 5, Assignment 7	Examine fuel properties, sketch and compare emission trends in engines	Flipped Classroom	1709.5	Class Quiz End Term

A. 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
ME 1709.1	Describe the design process and basic CAD practices for engineering design and drawing	2											1	2		
ME 1709.2	Evaluate the CAD transformations and curve fitting	2	3											1		
ME 1709.3	Illustrate the core concepts of computer graphics	2		1												
ME 1709.4	Represent parametric cubic, Bezier, B-spline curves and surfaces and solids	3			1									2		
ME 1709.5	Possess a good understanding of solid modelling for employability in design of components.			1	2								3	2		

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering
Department of Mechanical Engineering
Course Hand-out
Power Plant Engineering | ME1757 | 3 Credits | 3 0 0 3
Session: Jul 18 – Dec 18 | Faculty: Dr. Avanish Singh Chauhan | Class:B.Tech. Sem. VII

A. Introduction: In the present scenario world is facing prolonged energy crisis. To overcome this crisis, the design of efficient power stations is very important for mechanical engineering students. Power plant engineering course provides good understanding and working of different types of power plants. This course is an elective course designed for students of mechanical engineering discipline to acquire quality knowledge in the area of power generation. Prior knowledge of vapour-power cycle, Otto cycle, diesel cycle has been implemented to study different types of power generation plants viz. steam power plant, diesel power plant, gas power plant, nuclear power plant, and hydro power plant. Site selection and economics of power plant has also been incorporated in the course for comprehensive understanding of power plants.

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

[ME1757.1] Understand the basics of various types of power plants along with economic aspects, site selection, and environmental effects.
[ME1757.2] Analyze the working principle and various components of steam power plant for employability.
[ME1757.3] Explain the components and working of diesel and gas power plants
[ME 1757.4] Elaborate the details of nuclear power plant along with safety measures.
[ME 1757.5] Describe the classification and components of hydro-electric power plant.

C. Program Outcomes and Program Specific Outcomes

[PO.01]. **Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

[PO.02]. **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.03]. 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.04]. **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.05]. **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 under- standing of the limitations.

[PO.06]. **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.07]. 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.08]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice**.**

[PO.09]. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.

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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.

PROGRAM SPECIFIC OUTCOMES

[PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software.

[PSO.2]. Alternative Fuels:-Analyse performance of I. C. engines attributed to alternate fuels.

[PSO.3]. Synthesis and Manufacturing: Synthesize advance materials for mechanical engineering applications.

S. Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	20
	Sessional Exam II (Closed Book)	20
	Quizzes 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.	
Home Work (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 evaluated for internal assessment.	

T. Syllabus

Steam power plant, Rankine cycle improvisation, Layout, Components and accessories, Steam and heat rate, Coal and ash handling systems, Draught system, Feed water system, Binary cycles and cogeneration systems. Diesel and Gas Turbine Plant: Otto, Diesel, Dual & Brayton Cycle - Analysis & optimization, Components, Combined cycle power plants. Nuclear Power Plants: Location, Component of nuclear plants, Types of reactors, Uranium enrichment, Safety, Disposal of nuclear waste, Comparison with thermal plants, Safety measures for nuclear power plants. Hydro-electric power plant: Classification, components and auxiliaries.

Major Hydro plants in India, Power plant economics: power tariff types, load distribution parameters, load curve, site selection, pollution control.

F. Text Book:

T1 R. K. Rajput, Power Plant Engineering., Laxmi Publications (P) Ltd.

T2. R. Yadav, Steam and Gas Turbines and Power Plant Engineering, Central Pub House-Allahabad.

G. References:

R1.P. K. Nag, Power Plant Engg., Tata McGraw Hill Publishing Co Ltd.

R2.G. R. Nagpal, Power Plant Engineering, Khanna Publishers.

R3.M. M. Wakil, Power Plant Technology, McGraw Hill International.

L. Lecture Plan:

Lec No	Topics	Session Outcomes	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction to Power Plant Engineering.	Outline of the course. Know the basics of different types of power plants.	Lecture	ME1757.1	Assignments, Class Quizzes, MTE-I, ETE.
2	Review of Thermo-dynamic cycles	Review of knowledge about thermodynamic cycles which are used in power plants.	Flipped Class	ME1757.1	
3	Power plant economics: Introduction, Load-duration curves	Understand the terms and definitions related to power plant economies.	Lecture	ME1757.1	
4	Power tariff types, Cost Analysis	Understand the power tariff management and apply cost analysis methods	Lecture, Activity	ME1757.1	
5	Site selection	Understand the site selection criteria	Lecture	ME1757.1	
6	Pollution and its control	Understand the environmental effects of power plants and contemplate on renewable energy / green energy options	Lecture, Activity	ME1757.1	
7	Introduction to Steam Power Plant, Working Principle	Understand the working of a steam Power plant	Lecture	ME1757.1 ME1757.2	
8	Improvement of Rankine cycle	Understand the improvisation criteria of basic Rankine cycle	Lecture	ME1757.2	
9	General Layout, Coal Burning Methods	Understand the deciding criteria for layout of power plant along with methods of coal burning.	Lecture	ME1757.2	
10	Coal and Ash handling systems	Understand the coal and ash handling systems in power plant	Lecture	ME1757.2	
11	Chimney Draught, Calculation of Chimney Height	Understand the functions of chimney and apply the knowledge for calculation of chimney height	Lecture, Activity	ME1757.2	

12	Boilers and accessories	Discuss various types of boilers and their accessories	Flipped Class	ME1757.2	
13	Steam Turbines	Describe the working of steam turbines	Lecture	ME1757.2	
14-15	Feed Water System, condensers	Describe feed water system and condensers.	Lecture	ME1757.2	
16	Cooling towers	Understand the working of various types of cooling towers	Lecture	ME1757.2	
17	Binary cycle and cogeneration systems	Describe the usage of binary cycle and cogeneration system for power generation	Flipped Class	ME1757.2	
18	Introduction to Diesel Cycle Plant, General Layout of Diesel Cycle Plant and Plant Components	Understand the components and working of diesel power plant	Lecture	ME1757.1 ME1757.3	Assignments, Class Quizzes, MTE-II, ETE.
19	DG Plant	Demonstrate the components and working of DG plant	Lab/Field Visit	ME1757.3	
20	Introduction to Gas Turbine Plant, General Layout of Gas Turbine Plant and Plant Components	Understand the components and working of gas power plant	Lecture	ME1757.3	
21	Combined cycle power plant	Analyze the usage of combined cycle for power generation	Flipped Class, Lecture	ME1757.3	
22	Introduction to Nuclear Power Plant	Understand the basics of nuclear power plant	Lecture	ME1757.1 ME1757.4	
23	Nuclear Plant Location, Different Nuclear Power Plant in India and Developing Countries	Contemplate the factors influencing the location of a nuclear power plant.	Flipped Class	ME1757.1 ME1757.4	
24-25	Components of Nuclear Power Plant	Understand the various components of nuclear power plant	Lecture	ME1757.4	
26	Reactors and their types	Describe the types and working of reactors used in nuclear power plant	Lecture	ME1757.4	
27	Uranium enrichment, safety and disposal of nuclear waste	Explain the process of Uranium enrichment and Discuss the safety aspects for dealing with nuclear waste	Lecture	ME1757.4	
28	Comparison of Nuclear and Thermal Power Plant	Analyze the differences between nuclear and thermal power plants with reference to energy source and working	Flipped Class, Activity	ME1757.2 ME1757.4	

29	Safety measures for nuclear power plant	Identify the safety measures associated with nuclear power plant	Lecture	ME1757.4	
30	Introduction and Classification of Hydro-electric Power Plant	Understand the basics of hydro-electric power plants	Lecture	ME1757.1 ME1757.5	Assignments, Class Quizzes, ETE
31-32	Advantages and Disadvantages of water power, optimization of hydro-thermal mix	Explain various characteristics of water as a power source	Lecture	ME1757.5	
33	Component and Auxiliaries of Hydro-electric Power Plant	Describe the components and auxiliaries used in the working of hydro power plant	Lecture	ME1757.5	
34	Comparison of Hydro plant and Thermal Power Plant	Analyze the differences between hydro and thermal power plants with reference to energy source and working	Flipped Class, Activity	ME1757.2 ME1757.5	
35	Major Power Plants in India	Identify and discuss various power plants located in India	Flipped Class, Activity	ME1757.1 ME1757.2 ME1757.3 ME1757.4 ME1757.5	
36	Comparative review of power plants	Comparative analysis of various types of power plants with reference to available resources and environmental impacts	Activity	ME1757.1 ME1757.2 ME1757.3 ME1757.4 ME1757.5	

M. 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
ME1757.1	Understand the basics of various types of power plants along with economic aspects, site selection and environmental effects	2	2	3	2	1	3	3			1	2			1	
ME1757.2	Describe working principle and various components of steam power plant for employability.	3	1		1											

ME1757.3	Explain the components and working of diesel and gas power plants	3	1		1											
ME1757.4	Elaborate the details of nuclear power plant along with safety measures	3	1	1	1		2	2							1	
ME1757.5	Describe the classification and components of hydro-electric power plant	3	1		1										1	

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering
Department of Mechanical Engineering
Course Hand-out
Renewable Energy Systems| ME 1758 | 4 Credits | 3 0 0 3
Session: July 18 – Dec. 18 | Faculty: Dr. Ravi Kumar Sharma | Class: B. Tech.Sem.VII

A. Introduction: Renewable energy sources derive their energy from existing flows of energy from ongoing natural processes, such as sunshine, wind, flowing water, biological processes, and geothermal heat flows. A general definition of renewable energy sources is that renewable energy is captured from an energy resource that is replaced rapidly by a natural process such as power generated from the sun or from the wind. Currently, the most promising (aka economically most feasible) alternative energy sources include wind power, solar power, and hydroelectric power. Other renewable sources include geothermal and ocean energies, as well as biomass and ethanol as renewable fuels. This subject also impart the knowledge of energy storage.

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

[ME1758.1] Analyse the main sources of energy and their primary applications in the INDIA, and the world.

[ME1758.2] Evaluate the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the environment.

[ME1758.3]Create remedies/potential solutions to the supply and environmental issues associated with fossil fuels and other energy resources.

[ME1758.4] Select the primary renewable energy resources and technologies for skill development.

[ME1758.5] Develop the basic electrical concepts and system components related to renewable sources.

[ME1758.6]Thermal energy storage using appropriate materials.

D. Program Outcomes and Program Specific Outcomes

[PO.01]. **Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

[PO.02]. **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.03]. 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.04]. **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.05]. **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 under- standing of the limitations.

[PO.06]. **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.07]. 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.08]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice**.**

[PO.09]. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.

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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.

PROGRAM SPECIFIC OUTCOMES

[PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software.

[PSO.2]. Alternative Fuels:-Analyse performance of I. C. engines attributed to alternate fuels.

[PSO.3]. Synthesis and Manufacturing: Synthesize advance materials for mechanical engineering applications.

B. Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	15
	Sessional Exam II (Close Book)	15
	Online 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.	

C. Syllabus

Introduction: Different forms, Sources, Need for renewable energy sources, **Solar energy**: Sun as source of energy, Solar air heaters, Cooking, Drying, Distillation, Space heating, Refrigeration, Power generation: Low, medium and high temperature cycle, **Solar radiation at the earth's surface:** Measurement of solar radiation, solar radiation geometry, **Wind power:** Total and maximum power (Betz theory), Actual power, Types of windmill, Wind turbine operation, Forces on the blades and thrust on turbines, **Biomass:** Types of biomass, Biogas production from organic waste by an aerobic fermentation, **Conversion of energy**: Thermal, chemical and electromagnetic energy into electricity, **Energy Storage**: Different modes of energy storage, Phase change materials, Selection criteria of PCMs, classification of PCMs.

D. Text Books

T1. S P Sukatme, Solar Energy Principles of Thermal Collection and Storage, Tata Mc Graw Hill, 2005.
T2. G. D. Rai, Non-conventional Energy Sources, Khanna Publications, 2011.
T3. H. P. Garg and J. Prakash, Solar Energy: Fundamentals and Applications, McGraw Hill Education, 2017.

E. Reference Books

R1. S Rao and Dr. B B Parulekar, Energy Technology, Khanna Publishers, 2004.
R2. B H Khan, Non-conventional energy resources, Mc Graw Hill, 2017.

F. Lecture Plan:

Lec No	**Topics**	**Session Outcomes**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing the Outcome**
1,2,3	Introduction: Different forms of energy	Recall about the energy and their different types of conversion	Lecture		NA
4,5	Sources of energy	Discuss about bases of energy from where get the individual one	Flipped Classroom	[1758.1]	Cross questioning in the class
6,7	Need for renewable energy sources	Justify the reason behind the need of alternate sources as well as renewable too	Activity (Think Pair Share)	[1758.1], [1758.2], [1758.3], [1758.7]	In Class Quiz
8	India's production and reserves of Commercial energy sources and potential of Renewable energy resources	Brief about the potential source of energy available	Lecture	[1758.1] [1758.2] [1758.3] [1758.6]	Home Assignment
9,10	Solar air heaters	Implementation of solar renewable energy	Lecture	[1758.4]	In Class Quiz
11,12	Cooking, Drying, Distillation, Space heating	Design technique to use the solar energy	Activity (Think Pair Share)	[1758.4]	Home Assignment
13,14	Refrigeration	Compare the conventional system with renewable use	Activity (Reciprocal teaching)	[1758.5]	Home Assignment
15,16	Power generation-low, medium and high temperature cycle	Identify the generation according to temperature range	Flipped Class	[1758.4]	Class Quiz
17,18	Solar radiation at the earth's surface: Measurement of solar radiation	Explain about the relation between solar radiation and earth location	Lecture		Class Quiz
19,20	Solar radiation geometry	Solve the geometry angles related to intensity of solar	Activity (Think Pair Share)		Class Quiz
21,22	Principles of wind power	Explain the working of wind turbines	Lecture	[1758.6]	Class Quiz

23,24	Total power, maximum power (Betz theory), Actual power	Apply the mathematical relations to find out the power generated by wind turbines	Flipped Class		Class Quiz
25,26	Types of windmill	Explain about different windmills according to their design and working	Lecture	[1758.4]	Class Quiz
27,28	Wind turbine operation	Explain the operational differences of different wind turbines	Lecture		Class Quiz
29	Forces on the blades and thrust on turbines	Calculate the forces activating on turbine	Activity (Think Pair Share)	[1758.6]	Home Assignment Class Quiz
30,31	Ocean energy	Identify how the energy can be extracted by the ocean	Jigsaw	[1758.4]	Class Quiz
32	Small scale Hydel Plant	Design a small scale plant which is extracting the energy from water	Activity (Think Pair Share)	[1758.5]	Class Quiz
33,34	Geothermal energy conversion	Brief and identify the way to convert or use of geothermal energy	Lecture, Activity	[1758.4]	Class Quiz
35,36	Types of biomass	Explain about the ways from biomass can be produced	Lecture, Jigsaw		Home Assignment Class Quiz
37,38	Biogas production from organic waste by an aerobic fermentation	Create & Justify the process of biogas production	Flipped Class, Jigsaw	[1758.4]	Class Quiz
39,40	Conversion of thermal energy into electricity - Thermo-electric converters	Clarify the conversion technique through thermos-electric convertors	Flipped Class	[1758.5], [1758.6]	Class Quiz
41,42	Thermal energy storage	Clarify the energy storage and materials	Flipped Class	[1758.5]	Class Quiz
43,44	Organic and inorganic phase	Classifications and properties	Lecture, Flipped	[1758.5], [1758.6]	Home Assignment

	change materials		Class		Class Quiz

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES	CORRELATION WITH PROGRAM SPECIFIC OUTCOMES													
		PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ME 1758.1	Analyse the main sources of energy and their primary applications in the INDIA, and the world.	2														
ME 1758.2	Evaluate the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the environment.		3					2								
ME 1758.3	Create remedies/potential solutions to the supply and environmental issues associated with fossil fuels and other energy resources.			3		2		2								

ME 1758.4	Select the primary renewable energy resources and technologies.					3										
ME 1758.5	Develop the basic electrical concepts and system components related to renewable sources.	2		3										2		2
ME 1758.6	Thermal energy storage						2			2						

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering
Department of Mechanical Engineering
Course Hand-out
Aerodynamics | ME 1759 | 3 Credits | 3 0 0 3
Session: July 18 – Nov. 18 | Faculty: DrVinod Yadav/B.Tech. Semester VII

A. Introduction: This course will provide each student with the principles and information necessary to understand the forces that act upon both airborne and stationary objects. The course introduces the students to the equations of motion for incompressible flow and applies them to solve for the velocity, pressure, and shear stress distributions on airfoils and other shapes.

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

[ME 1759.1] Understand the theoretical concepts underlying the development of lift, drag, and movement forces on aeronautical vehicles employability in automobile sector.

[ME 1759.2]) Be able to visualize the flow around aeronautical vehicles and physically understand the concepts of pathlines, streamlines, and vorticity.

[ME 1759.3] Understand the concept of superposition of elementary flows for linear incompressible flow.

[ME 1759.4] Analyse the characteristics of airfoil geometries and platform shapes to assist in determining aircraft performance.

[ME 1759.5] Be equipped to evaluate new lift-enhancement or drag-reduction devices and appreciate the directions and promise of upcoming developments in aerodynamic technology

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 under- standing 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.

PROGRAM SPECIFIC OUTCOMES:

[PSO.1]. Modelling & Analysis: Model and analyse mechanical engineering components using advanced software.

[PSO.2]. Alternative Fuels:-Analyse performance of I. C. engines attributed to alternate fuels.

[PSO.3]. Synthesis and Manufacturing: Synthesize advance materials for mechanical engineering applications.

Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Open Book)	15
	Sessional Exam II (Open Book)	15
	Quizzes (Open Book/Close Book) and Assignments	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.	
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.	

D. Syllabus

Review of potential flow, Method of images, Source panel method, Thin airfoil theory, Symmetric/Cambered airfoils, flapped airfoil, Vortex panel method, Wings: Down wash and induced drag, Elliptic and general lift distribution, Twisted wing, Numerical methods for wings, Basics of compressible flow and thermodynamics, One dimensional compressible flow, Normal and oblique shock waves, Expansion waves, Linearized compressible flow, Compressibility corrections, Wing body combinations.

F. Text Book:

T1. A.M. Kuethe and C.Y. Chow, *Foundations of Aerodynamics*, Wiley, 5th Edition, 1997.
T2. A. Motes, *Physics of Flight: An Introduction*, AM Photonics, 4th Edition, 2016.

G. Reference Book:

R1. R.T. Hill, *Basic theories of Aeronautics*, Raymond T Hill, 3rd Edition, 2014.

G. Lecture Plan:

Lec No	**Topics**	**Session Objective**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing the Outcome**
1	Course Hand-out briefing	To acquaint teacher's expectations and understand student expectations	Lecture	NA	NA
2	Review of Thermodynamics	Brief about the basics of Thermodynamics	Lecture, Activity	NA	NA
3	Review of Fluid Mechanics	Brief about the basics of Fluid mechanics	Lecture, activity	NA	NA
4	Potential Flow (I)	Understand the 2D and standard flow	Lecture	ME 1759.1 ME 1759.2	Home Assignment Mid-Term I End-Term
5	Potential Flow (II)	Understand the Axisymmetric Flows	Lecture		
7,8	Computational (Panel) Methods	Learn how computational tools are applied for predicting the potential flows	Lecture, Flip class	ME 1759.1 ME 1759.2	Home Assignment and Class Quiz Mid-Term I End-Term
9	Development of Airfoil Theory	Learn how to apply potential-flow theory to solve for the pressure distribution on the airfoil (or lifting wing section).	Lecture, activity	ME 1759.1 ME 1759.4	
10	General Thin-Airfoil Theory		Lecture/ Flip class	ME 1759.1 ME 1759.4	Home Assignment Mid-Term I End-Term
11	Solution to the General Equation	Learn how flapped airfoils and jet flaps work.	Lecture	ME 1759.3 ME 1759.4	
12	The Flapped Airfoil		Lecture	ME 1759.3 ME 1759.4	Home Assignment and Class Quiz Mid-Term I
13	Computational (Panel) Methods	Learn how to deal with arbitrary shaped airfoils by applying surface	Flip class	ME 1759.3 ME 1759.4	

		distributions of singularities using relatively powerful computational panel methods.			End-Term
14	Review and Class Quiz	Assessment and Revision of concepts	Activity	NA	NA
15	Vortex panel method	Learn the concept of a vortex line and explore features of the velocity field induced by the vortex line.	Lecture/Activity	ME 1759.3 ME 1759.4	Home Assignment and Class Quiz Mid-Term II End-Term
16	Laws Of Vortex Motion		Lecture	ME 1759.3 ME 1759.4	
17,18	The Wing as a Simplified Horseshoe Vortex	Understand the logical extension of a vortex line to a horseshoe vortex, and apply the horseshoe vortex model to develop Prandtl's lifting-line theory for modelling wing performance	Lecture	ME 1759.3 ME 1759.4	Class Quiz Mid-Term II End-Term
19	Vortex Sheets		Flip class	ME 1759.3 ME 1759.4	
20	Down wash and induced drag	Understand the phenomenon of induced drag and how Prandtl's lifting-line theory predicts induced drag quantitatively based on fundamental wing properties	Lecture, activity	ME 1759.3 ME 1759.4	Home Assignment Mid-Term II End-Term
21	Elliptic and general lift distribution		Lecture	ME 1759.4 ME 1759.5	
22	Computational (Panel) Methods For Wings		Lecture	ME 1759.3 ME 1759.4	Class Quiz
23	Basics of compressible flow and thermodynamics	Learn how elementary thermodynamics is incorporated into fluid dynamics to describe compressible	Lecture/Flip class	ME 1759.2 ME 1759.3	Home Assignment and Class Quiz

		flow			
24	Isentropic One-Dimensional Flow	Develop one-dimensional analysis to solve for fluid and thermodynamics property changes through a steady normal shock wave.	Lecture	ME 1759.2 ME 1759.3	Home Assignment and Class Quiz Mid-Term II End-Term
25	One-Dimensional Flow: Weak Waves		Lecture/Activity	ME 1759.2 ME 1759.3	
26	Plane Normal Shock Waves		Lecture	ME 1759.2 ME 1759.3	Home Assignment and Class Quiz End-Term
27	Mach Waves	Apply results of the analysis of steady normal shock to understand flow through oblique shock waves.	Lecture		
28	Plane Oblique Shock		Lecture	ME 1759.2 ME 1759.3	
29	Review and Class Quiz	Assessment and Revision of concepts	Activity	NA	NA
30	Transonic Flow	Develop subsonic linearized compressible flow theory for extending the trusted results from incompressible flow into high subsonic flight	Lecture	ME 1759.2 ME 1759.3	Home Assignment and Class Quiz End-Term
31	Subcritical Flow		Lecture	ME 1759.2 ME 1759.3	
32	Supersonic Linearized Theory	See how the different fluid physics for supersonic flow lead to a linearized solution different from that for subsonic compressible flow	Lecture	ME 1759.2 ME 1759.3	
33	Compressibility corrections		Lecture, activity	ME 1759.2 ME 1759.5	Class Quiz
34,35	Wing body combinations		Lecture/Flip class	ME 1759.4 ME 1759.5	Home Assignment and Class Quiz End-Term

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
ME 1759.1	Understand the theoretical concepts underlying the development of lift, drag, and movement forces on aeronautical vehicles employability in automobile sector.	3	3													
ME 1759.2	Be able to visualize the flow around aeronautical vehicles and physically understand the concepts of pathlines, streamlines, and vorticity	3														
ME 1759.3	Understand the concept of superposition of elementary flows for linear incompressible flow	3														
ME 1759.4	Analyse the characteristics of airfoil geometries and planform shapes to assist in determining aircraft performance	3	2													
ME 1759.5	Be equipped to evaluate new lift-enhancement or drag-reduction devices and appreciate the directions and promise of upcoming developments in aerodynamic technology	3				1	1						2			

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