MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Automobile Engineering

Program Outcomes and Program Specific Outcomes

B.Tech –Automobile Engineering | Academic Year: 2019-20

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]. **Autotronics and Electric Vehicle Technology:** Apply_knowledge of electrical and electronics engineering for providing automobile engineering solutions

[PSO.2]. **Alignment to Super Qualification packs of ASDC:** Demonstrate knowledge and performance criteria as defined by ASDC super qualification packs for R&D or Quality or Service Engineering

[PSO.3]. **Application of Lean Six Sigma Methodology:** Demonstrate through an internship project, the knowledge and understanding of lean six sigma methodology based on Define, Measure, analyse, improve/develop and control/validate phases (DMAIC/ DMADV).

PROGRAM ARTICULATION MATRIX

S.N.O.	Course CODE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CS 1101	3	1	3	0	0	0	0	0	0	0	0	3	0	0	0
2	CS1030	3	1	3	0	0	0	0	0	0	0	0	3	0	0	0
3	CV1001	3	3	2	3	3	2	2	0	3	2	3	3	0	0	0
4	CY1001	2	2	2	0	3	0	3	2	0	3	0	3	0	0	0
5	CY1002	3	3	1	2	3	3	3	3	3	0	1	3	0	0	0
6	CY1030	2	0	2	0	3	0	3	2	0	3	0	3	0	0	0
7	EC1001	3	3	3	2	2	1	1	0	0	0	0	2	0	0	0
8	EE 1101	3	2	1	0	0	1	1	0	0	0	0	3	0	0	0
9	LN1001	0	1	0	0	0	1	0	2	2	2	1	0	0	0	0
10	MA1101	3	3	2	3	3	0	0	0	3	0	3	1	0	0	0
11	ME1001	3	3	3	2	0	2	2	0	0	0	0	0	0	0	0
12	ME1002	3	3	3	2	3	0	0	0	0	0	0	2	0	0	0
13	ME1030	1	1	0	0	1	0	1	0	1	0	1	1	0	0	0
14	PY1001	3	3	3	2	2	2	2	2	2	2	2	2	0	0	0
15	PY1030	3	3	1	2	2	3	2	2	3	2	1	2	0	0	0
16	MA 1313	3	2	1	1	2	0	0	0	0	2	0	1	0	0	0
17	AU 1302	3	0	2	0	0	3	2	0	0	0	0	1	1	2	0
18	AU 1305	3	3	3	2	0	0	0	0	0	0	0	1	0	1	0
19	AU 1306	3	0	0	0	0	0	0	0	0	3	3	3	0	3	0
20	AU 1308	3	2	0	2	0	2	2	2	2	0	3	0	2	2	0
21	EO1323	0	0	0	0	0	1	0	0	2	0	2	3	0	0	0
22	MA 1410	1	1	0	1	0	0	0	0	0	1	0	0	0	0	0
23	AU 1407	2	1	2	3	2	3	2	2	2	0	1	3	1	2	2
24	AU 1409	3	2	3	2	0	0	0	1	2	0	0	0	0	1	0
25	AU 1410	3	2	2	0	0	2	2	0	1	0	0	0	0	1	0
26	BB 1540	0	0	0	0	0	0	0	0	2	2	3	0	0	0	0
27	AU 1512	2	3	2	0	0	2	2	2	2	0	3	0	0	3	0
28	AU 1513	3	2	3	2	0	0	0	1	2	0	0	0	0	0	0
29	AU 1514	3	3	3	0	0	0	0	0	0	0	0	1	0	0	0
30	AU 1553	3	2	2	2	2	2	0	2	3	1	2	1	0	0	0
31	AU 1554	3	2	0	2	1	0	0	0	1	0	1	3	0	0	0
32	AU 1555	1	0	3	0	2	1	2	0	0	1	0	0	0	0	0
33	AU 1602	3	2	3	2	0	0	0	1	2	0	0	0	2	1	0
34	AU 1606	2	2	1	3	3	2	2	0	2	1	2	2	3	1	1
35	AU 1607	3	3	3	3	2	1	3	0	3	2	2	2	0	3	3

36	AU 1657	3	3	3	0	2	1	0	1	2	1	1	1	1	3	1
37	AU 1658	1	2	1	2	3	1	2	2	1	0	0	2	0	0	1
38	AU 1659	1	0	3	0	2	1	2	0	0	1	0	0	0	0	0
39	AU 1660	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0
40	AU 1661	2	2	3	3	1	2	2	1	2	2	3	2	2	2	0
41	AU 1662	1	0	3	0	2	1	2	0	0	1	0	0	0	0	0
42	AU 1704	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43	AU 1705	3	2	0	2	0	2	2	2	2	0	3	0	2	2	0
44	AU 1707	3	2	3	2	0	0	0	1	2	0	0	0	2	1	0
45	AU 1760	0	2	2	3	0	0	1	2	2	0	1	0	0	0	0
46	AU 1761	3	3	3	1	2	0	0	2	2	0	2	0	0	3	2
47	AU 1762	3	2	3	2	0	0	0	1	2	0	0	0	2	1	0
48	AU 1763	3	2	2	2	2	2	0	2	3	0	2	0	0	0	0
49	AU 1764	2	3	3	3	3	3	3	2	3	3	3	2	0	3	1
50	AU 1765	3	2	0	1	1	0	0	0	1	1	1	3	0	0	0
51	AU 1766	3	2	2	2	3	2	0	2	3	1	2	0	0	0	0
52	AU 1881	0	3	3	3	2	1	2	2	2	0	0	3	2	3	3

MANIPAL UNIVERSITY
JAIPUR

School of Computing and Information Technology

Course Hand-out

Problem Solving Using Computers

| CS 1001 | 3 Credits | 3 0 0 3

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

A. **Introduction:** Programming in C focuses on basic computer fundamentals, number system and programming fundamentals. By means of C language students learn to write set of instruction to create a program so that desire output can be generated by computer.

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

[1001.1]. Demonstrate bitwise operations and conversion of numbers in different representations through Number System.

[1001.2]. Demonstrate a deep knowledge of computer for better understanding of devices, basic fundamental of computer comprises in this course.

[1001.3]. Design flow chart, Write algorithm and pseudo code parallel with Control Statements to understand flow of program execution.

[1001.4]. Create memory oriented operation using pointers and understating programming skills by Array, Structure, Union, Enum and String are added.

[1001.5]. Create program using concept of re-usability by means of functions in C.

[1001.6]. Illustrate the concept of data base by using file handling.

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

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

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

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

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

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern

engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

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

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

D. Assessment Plan:

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

E. SYLLABUS

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

F. Text Books

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

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

G. Reference Books

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

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

H. Lecture Plan:

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

12	Input and output statements (formatted and unformatted) : printf, scanf	Implementation of input and output statements	Lecture	1001.3	Mid Term I, Quiz & End Term
13	Gets, puts, getchar, putchar	Implementation of input and output statements using system functions	Activity (Jigsaw)	1001.3	Mid Term I, Quiz & End Term
14	Decision statements: if, if-else, nested if-else, if-else ladder	Implementation of decision statements	Lecture	1001.3	Mid Term I, Quiz & End Term
15	Decision statements: if, if-else, nested if-else, if-else ladder	Implementation of decision statements	Lecture	1001.3	Mid Term I, Quiz & End Term
16	Switch, break statement	Learning the implementation of switch and break	Flipped Class	1001.3	Mid Term I, Quiz & End Term
17	Switch, break statement	Learning the implementation of switch and break	Lecture	1001.3	Mid Term I, Quiz & End Term
18	Repetitive structures: for, while, do-while	Learning the implementation of looping	Lecture	1001.3	Mid Term II, Quiz & End Term
19	Repetitive structures: for, while, do-while	Learning the implementation of looping	Lecture	1001.3	Mid Term II, Quiz & End Term
20	Nested loops	Learning the implementation of looping	Activity (Think Pair Share)	1001.3	Mid Term II, Quiz & End Term
21	Nested loops	Learning the implementation of looping	Lecture	1001.3	Mid Term II, Quiz & End Term
22	Continue and break statements	Describe the usage of continue and break	Lecture	1001.3	Mid Term II, Quiz & End Term
23	Continue and break statements	Describe the usage of continue and break	Lecture	1001.3	Mid Term II, Quiz & End Term
24	1-D array: definition, declaration, initialization, input array, output array	Describe and define array of various data type	Lecture	1001.4	Mid Term II, Quiz & End Term

25	1-D array: definition, declaration, initialization, input array, output array	Describe and define array of various data type	Lecture	1001.4	Mid Term II, Quiz & End Term
26	1-D character array: character array, string, string standard function	Describe and define array of various data type	Lecture	1001.4	Mid Term II, Quiz & End Term
27	1-D character array: character array, string, string standard function	Describe and define array of various data type	Lecture	1001.4	Mid Term II, Quiz & End Term
28	1-D character array: character array, string, string standard function	Describe and define array of various data type	Lecture	1001.4	Mid Term II, Quiz & End Term
29	2-D array: definition, declaration, initialization, input array, output array, one simple program	Describe and define array of various data type	Lecture	1001.4	Mid Term II, Quiz & End Term
30	2-D array: definition, declaration, initialization, input array, output array, one simple program	Describe and define array of various data type	Lecture	1001.4	Mid Term II, Quiz & End Term
31	2-D array: definition, declaration, initialization, input array, output array, one simple program	Describe and define array of various data type	Lecture, Activity	1001.4	Mid Term II, Quiz & End Term
32	Pointers: introduction	Describe functionality of pointers in programming'	Lecture	1001.4	Mid Term II, Quiz & End Term
33	1-D Array and pointer	Implementation of ID array with pointer	Lecture	1001.4	Mid Term II, Quiz & End Term
34	Functions: introduction to functions	Describe importance of fuction and modular programming	Lecture, Activity	1001.5	Mid Term II, Quiz & End Term
35	Function prototype, call, definition	Describe importance of fuction and modular programming	Lecture	1001.5	Mid Term II, Quiz & End Term
36	Storage classes	Describe usage of storage classes	Lecture	1001.5	Mid Term II, Quiz & End Term

37	Structures: definition, declaration, initialization, array of structures	Describe usage of structures	Lecture	1001.4	Quiz & End Term
38	Structures: definition, declaration, initialization, array of structures	Describe usage of structures	Lecture	1001.4	Quiz & End Term
39	Union, difference between union and structures	Describe usage of union	Lecture	1001.4	Quiz & End Term
40	File handling: introduction, operations on files, opening modes	Describe usage of file handling with various operations and modes	Lecture	1001.6	Quiz & End Term
41	File handing function	Describe usage of file handling with various operations and modes	Lecture	1001.6	Quiz & End Term
42	File handing function	Describe usage of file handling with various operations and modes	Lecture	1001.6	Quiz & End Term

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

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

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

MANIPAL UNIVERSITY
JAIPUR

School of Computing and Information Technology

Course Hand-out

Problem Solving Using Computers Lab

| CS 1030 | 1 Credits | 0 0 1 1

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

A. Introduction: Problem Solving Using Computers focuses on basic computer fundamentals, number system and programming fundamentals. By means of C language students learn to write set of instruction to create a program so that desire output can be generated by computer.

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

[1030.1]. Demonstrate bitwise operations and conversion of numbers in different representations through Number System.

[1030.2]. Demonstrate a deep knowledge of computer for better understanding of devices, basic fundamental of computer comprises in this course.

[1030.3]. Design flow chart, Write algorithm and pseudo code parallel with Control Statements to understand flow of program execution.

[1030.4]. Create memory oriented operation using pointers and understating programming skills by Array, Structure, Union, Enum and String are added.

[1030.5]. Create program using concept of re-usability by means of functions in C.

[1030.6]. Illustrate the concept of data base by using file handling.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

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

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

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practice

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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

D. Assessment Plan:

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

E. SYLLABUS

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H. Lab Experiment Plan:

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

9	2-D Arrays	Implement different Operations on arrays	Lecture	1030.4	Mid Term I, Quiz & End Term
10	Strings	Implementation of precedence in programing	Lecture	1030.4	Mid Term I, Quiz & End Term
11	Functions	Use functions to solve the given problem	Lecture	1030.5	Mid Term I, Quiz & End Term
12	Pointers	Understand pointers, structures and unions	Lecture	1030.5	Mid Term I, Quiz & End Term
13	Structures	Understand pointers, structures and unions	Activity (Jigsaw)	1030.6	Mid Term I, Quiz & End Term
14	End Term Exam				

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

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

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

MANIPAL UNIVERSITY JAIPUR

School of Civil and Chemical Engineering

Department of Civil Engineering
Course Hand-out

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

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

A. Introduction:

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

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

[CV1001.1]. Importance and role of Civil Engineering and Civil Engineer in development of Society.

[CV1001.2]. Get familiar with surveying and the type of instruments used for surveying.

[CV1001.3]. Describe the scientific terminologies related to building materials and components of building.

[CV1001.4]. Assess the force acting on a materials, centre of gravity and moment of inertia of composite area.

[CV1001.5]. Calculate the different type of stress like, simple stress, shear stress, and direct stress and strain in the material, and analysis of truss. Familiar to basic terminologies related to Estimation and Costing which create employability, and entrepreneurship.

C. Program Outcomes and Program Specific Outcomes

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

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

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

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

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

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

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

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

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

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

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

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

D. Assessment Plan:

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

E. Syllabus

Introduction:- Scope of Civil Engineering, Role of Civil Engineer in Society, Impact of infrastructural development on economy of country; **Surveying:-**Principles and types of surveying, Site plans, Linear measurements, Angular measurements, Levelling, ordinary levels and total stations, Use of theodolite and plane table, contouring, L- section and cross sections; **Buildings:-** Properties, uses of Stones, bricks, cement, timber, steel, plastics and paints. Properties of concrete. Selection of site for Buildings, Layout of building Plan, Types of buildings, Plinth Area, Carpet Area, Super built up area, floor space index, building bye laws, ventilation, components of buildings and their functions, Functional design of buildings, basic concepts of R.C.C., Type of foundations; **Mechanics of Solids**:- Forces and Equilibrium, Graphical and analytical treatment of concurrent and non-concurrent co-planer forces, Free body diagram, Frictional force in equilibrium problems; **Centroid and centre of gravity**, Moment of inertia of simple and composite areas; **Normal stress and strain**, Hooke's law, modulus of elasticity, modulus of rigidity, allowable stress, shear stress and shear strain; **Analysis of plane truss**, Method of joints, Method of sections; **Estimation and Costing**:- Types of estimates and Contracts, Tenders, NIT, EMD and Security deposits, Award of work, measurements, billing and payments.

F. Text Books

T1. Ramamrutham S., Basic Civil Engineering (3e), Dhanpat Rai Publishing Company (P) Ltd, 2013.

T2. Punamia B. C., Jain A. K., Jain A. K., Surveying Volume 1 (16e), S Chand, 2016.

T3. Dutta B. N., Estimation and Costing in Civil Engineering (28e), UBS Publishers Distributors LTD., 2016.

T4. Punamia B.C., Jain A. K., Jain A. K., Building Construction (11e), S Chand, 2016.

T5. Khurmi R. S., Strenght of Material, S Chand, 2016

T6. Timoshenko S., Young D.H., Rao J.V., Pati S., Engineering Mechanics (5e), Mcgraw Hill, 2013.

T7. SP41 Handbook on Functional Design of Buildings, Bureau of Indian Standards 2013.

Reference Books

R1. Timoshenko S., Young D.H., Rao J.V., Pati S., Engineering Mechanics (5e), Mcgraw Hill, 2013.

R2. SP41 Handbook on Functional Design of Buildings, Bureau of Indian Standards 2013.

G. Lecture Plan:

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

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

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

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

MANIPAL UNIVERSITY JAIPUR

Faculty of Engineering

Department of Chemistry
Course Hand-out

Engineering Chemistry | CY1001 | 3 Credits | 2 1 0 3

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

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

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

[1001.1]. Understand and apply concepts of various types of fuel technology

[1001.2]. Develop skill of synthesis and applications of polymer and some advanced materials.

[1001.3]. Explain different the water softening methods.

[1001.4]. Understand and apply the concepts in electrochemistry and corrosion science in protecting metallic objects.

[1001.5]. Apply the concept of phase rule to construct phase diagram

[1001.6]. Develop skill in various modern analytical techniques.

C. Program Outcomes and Program Specific Outcomes

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

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

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

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

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

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

D. Assessment Plan:

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

E. Syllabus

Unit-I Classification of Fuels, Gross Calorific value and Net Calorific value. Solid, Liquid and Gaseous fuels.
Unit-II: Advanced materials and polymers: Liquid crystals, ceramics, composites, bio-materials, nanomaterials, thin films and their properties and applications.
Unit-III: Water treatment technology.
Unit- IV: Concept of corrosion and its importance, types of corrosion, factors affecting corrosion, Corrosion control methods. Chemistry of primary and secondary batteries. Working principles of fuels cells and their applications.
Unit-V: Theory and application phase rule (up to two component system).
Unit VI; General methods of chemical analysis, Instrumental methods. Introduction to spectroscopic methods of analysis: Electromagnetic radiation (EMR), Interaction of EMR with matter, Numerical Problems. Concepts of rotational, vibrational and electronic spectra, Laws of spectrophotometry

F. Text Books

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

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

G. Reference Books

R1. None

H. Lecture Plan:

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

9.	Molecular weight of polymers, Number average and weight average molecular weights, Numerical problems.	Analyse and solve numerical problems	Lecture, Activity	1001.2	Class Quiz Mid Term I End Term
10.	Preparation, properties and applications of Polythene (LDPE and HDPE), Nylon(6:6, 6, 6:10, 11), PF resins and Polyester. Natural rubber, Processing of Natural Rubber, Vulcanization, Compounding of rubber; Synthetic Rubber: Buna-N, Buna-S	Identify alternative ways to synthesize rubbers.	Lecture	1001.2	Class Quiz Mid Term I End Term
11.	Liquid crystals: their properties and applications	Gain knowledge of liquid crystals	Lecture	1001.2	Class Quiz End Term
12.	Ceramics: Properties and applications	Gain knowledge of ceramics	Lecture	1001.2	Class Quiz Mid Term I End Term
13.	Composites and bio-materials: properties and applications	Gain knowledge of bio-materials	Lecture	1001.2	Class Quiz Mid Term I End Term
14.	Nanomaterials and thin films: Properties and applications	Understand basics of nanochemistry	Lecture	1001.2	Class Quiz Mid Term I End Term
15.	Revision	Recall and recap the lessons learnt during last 14 lectures	Lecture, Activity		Class Quiz Mid Term I End Term
16.	**Water Technology:** Introduction, Characteristics imparted by impurities in water, Hardness of water Degree of hardness.	Describe the properties of water and its aplication	Lecture	1001.3	Class Quiz Mid Term II End Term
17.	Determination of hardness by EDTA method. Numerical problems.	Describe working hardness/softness of water	Lecture, Activity	1001.3	Class Quiz Mid Term II End Term
18.	Softening of hard water: Internal treatment by phosphate and calgon condition. Softening of hard water: External treatment by lime soda process.	Describe working hardness/softness of water	Lecture	1001.3	Class Quiz Mid Term II End Term
19.	Softening of hard water: Ion exchange method; Zeolite methods	Describe working hardness/softness of water	Lecture.	1001.3	Class Quiz Mid Term II End Term
20.	Softening of hard water, internal treatment by phosphate, calgon condition and colloid conditioning	Describe working hardness/softness of water	Lecture	1001.3	Class Quiz Mid Term II End Term
21.	Numerical problems based on lime soda process.	Analyse and solve numerical problems	Lecture, Activity	1001.3	Class Quiz Mid Term II End Term

22.	**Corrosion and its Control:** Introduction, significance, types of corrosion, dry corrosion. Nature of oxide layers; PB Rule	Describe corrosion and its preventions	Lecture, Activity	1001.4	Class Quiz Mid Term II End Term
23.	Wet Corrosion: Electrochemical corrosion	Describe corrosion and its preventions	Lecture	1001.4	Class Quiz Mid Term II End Term
24.	Galvanic corrosion; Differential aeration corrosion: Pitting corrosion, Water line corrosion, Crevice corrosion.	Describe corrosion and its preventions	Lecture	1001.4	Class Quiz Mid Term II End Term
25.	Factors affecting corrosion: Nature of the metal, Nature of the Environment	Describe corrosion and its preventions	Lecture	1001.4	Class Quiz Mid Term II End Term
26.	Corrosion prevention by material selection and design alternation of environment by changing medium; Stress corrosion – Caustic embrittlement	Describe corrosion and its preventions	Lecture	1001.4	Class Quiz Mid Term II End Term
27.	Cathodic protection – sacrificial anode and impressed voltage methods, Anodic protection; Inhibitors – Anodic and Cathodic inhibitors, Protective coating – Metal coating (Electroplating, galvanization, Tinning).	Describe corrosion and its preventions	Lecture	1001.4	Class Quiz Mid Term II End Term
28.	Introduction and theory of batteries and fuel cells.	Gain knowledge of batteries	Lecture	1001.4	Class Quiz Mid Term II End Term
29.	Chemistry (working) of primary and secondary batteries.	Gain knowledge of batteries	Lecture	1001.4	Class Quiz Mid Term II End Term
30.	Working principles of fuels cells and their applications.	Gain knowledge of fuel cells	Lecture	1001.4	Class Quiz Mid Term II End Term
31.	**Revision**	Recall and recap the lessons learnt during last 14 lectures	Lecture, Activity		Class Quiz Mid Term II End Term
32	**The Phase Rule:** Definition, Phase rule equation, Phase, Component; Degree of freedom, examples to solve number of phase, component and degree of freedom	Gain knowledge of phase rule	Lecture	1001.5	Class Quiz End Term
33	One component system: Water system; Sulphur system	Gain knowledge of phase rule	Lecture	1001.5	Class Quiz End Term
34	Lead Silver system; Pattinson's process, Limitations of phase rule	Gain knowledge of phase rule	Lecture	1001.5	Class Quiz End Term

35	**General methods of chemical analysis, Instrumental methods:** Introduction, pH metric analysis, Conductrometric analysis. Chromatographic techniques.	Gain skill in various modern analytical techniques.	Lecture	1001.6	Class Quiz End Term
36	Paper chromatography (R_f value); Thin layer chromatography; Gas Chromatography;	Gain skill in various chromatographic techniques.	Lecture	1001.6	Class Quiz End Term
37	Introduction to spectroscopic analysis. Beer-Lambert's law; Numerical problems.	Gain skill in various modern analytical techniques.	Lecture, Activity	1001.6	Class Quiz End Term
38	Principle of UV visible spectroscopy.	Gain skill in analytical techniques using Uv-Vis spectroscopy.	Lecture	1001.6	Class Quiz End Term
39	Instrumentation of UV visible spectroscopy	Gain skill in analytical techniques using Uv-Vis spectroscopy.	Lecture	1001.6	Class Quiz End Term
40	Principle of IR (vibrational) spectroscopy.	Gain skill in analytical techniques using IR spectroscopy.	Lecture	1001.6	Class Quiz End Term
41	Instrumentation of IR spectroscopy	Gain skill in analytical techniques using IR spectroscopy.	Lecture	1001.6	Class Quiz End Term
42	Revision	Recall and recap the lessons learnt during the semester	Lecture, Activity		Class Quiz End Term

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

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

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

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Chemistry
Course Hand-out

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

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

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

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

[1002.1]. Develop fundamental skills in understanding the environment, ecology and ecosystem for sustainable development saving the environment.

[1002.2]. Apprehend environmental problems and its linkage to health and safety of society; think and act with a sense of responsibility, committing to the professional ethics.

[1002.3]. Impart knowledge on the application of the techniques / procedures to predict / qualitatively assess the reduction in the environmental impact for sustainable development.

[1002.4]. Promote the active involvement of oneself and society in designing the activities / processes with which the environment and ecosystem would be preserved, considering public health and safety.

[1002.5]. Explore the impacts of various man-made activities from an environmental context. Students can demonstrate the knowledge by participating in class debates and presentations on various topics of environmental concern with effective communication.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

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

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

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

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

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

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

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

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

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

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

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

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

D. Assessment Plan:

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

E. SYLLABUS

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

F. TEXT BOOKS

T1. Rajagopalan, R., Environmental Studies; From Crisis to Cure 3rd Edition, Oxford University Press, 2016.

T2. De, A. K. and De, A. K., Environmental Studies 2nd Edition, New Age International Publishers, New Delhi, 2009.

T3. Bharucha, E., Text book of Environmental Studies for undergraduate courses 4th Edition, Universities Press, Hyderabad, 2013.

G. REFERENCE BOOKS

R1. Tyler Miller, Jr. and Scott E. Spoolman., Environmental Science 13th Edition, Brooks/Cole, Cengage Learning, Belmont, CA, USA, 2010.

R2. Daniel B. Botkin and Edward A. Keller., Environmental Science - Earth as a Living Planet 8th Edition, John Wiley & Sons, INC. 2011.

Lecture Plan:

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

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

37	**Environmental impact assessment (EIA):** Methodology and importance	Explain the stages involved in EIA and it's importance before initiating a project	Lecture	**1002.4**	In Class Quiz End Term
38	**Human Population and the Environment:** Population growth, variation among nations, Population explosion – Family Welfare Program	Explain how population expansion is directly correlated to environmental degradation	Lecture	**1002.5**	End Term
39	**Case studies of Environmental issues**	Analyse case studies from different perspective and finding solutions	Lecture	**1002.5**	End Term
40	Practical activity related to environmental problems	In-class practical activity / discussion on environmental issues	Practical	**1002.5**	End Term
41	Practical activity related to environmental problems	In-class practical activity / discussion on environmental issues	Practical	**1002.5**	End Term
42	**Revision for ETE**	Revision for preparation for end term exam	Lecture	NA	NA
43	**Revision for ETE**	Revision for preparation for end term exam	Lecture	NA	NA

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

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

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

MANIPAL UNIVERSITY JAIPUR

Faculty of Engineering

Department of Chemistry
Course Hand-out

Engineering Chemistry Laboratory| CY1030 | 1 Credit | 0 0 2 1

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

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

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

[1030.1]. Develop skill in quantitative chemical analysis.

[1030.2]. Apply concept of synthetic chemistry.

[1030.3]. Analyse physical property of materials.

C. Program Outcomes and Program Specific Outcomes

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

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

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

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

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

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

D. Assessment Plan:

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

E. Syllabus

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

F. Text Books

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

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

G. Reference Books

R1. None

H. Lecture Plan:

Lec No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1.	Determination of trength of given unknown ferrous ammonium sulphate solution by titrating against standard $K_2Cr_2O_7$ using diphenylamine as an internal indicator	Develop skill in quantitative chemical analysis.	Activity	1030.1	Class Quiz End Term
2.	Determination of strength of given unknown ferrous ammonium sulphate solution by titrating against standard $K_2Cr_2O_7$ using potassium ferricyanide as an external indicator.	Develop skill in quantitative chemical analysis.	Activity	1030.1	Class Quiz Mid Term I
3.	Determination of the total, permanent and temporary hardness of given water sample by complexometric titration using EDTA solution	Develop skill in quantitative chemical analysis.	Activity	1030.1	Class Quiz End Term
4.	Determination of the strength of sodium carbonate and sodium hydroxide in given alkali mix. (water sample) hydrochloric acid is used as an intermediate solution, methyl orange and phenolphthalein used as indicators	Develop skill in quantitative chemical analysis.	Activity	1030.1	Home Assignment End Term
5.	Determination of the strength of ferrous Ammonium Sulphate by titrating against $KMnO_4$ solution	Develop skill in quantitative chemical analysis.	Activity	1030.1	Class Quiz End Term
6.	Preparation of urea formaldehyde resin	Apply concept of synthetic chemistry.	Activity	1030.2	Class Quiz Mid Term I End Term
7.	Determination of strength of given HCl solution using a standard NaOH solution by performing a pH-metric titration.	Analyse physical property of materials	Activity	1030.1	Class Quiz Mid Term I End term
8.	Determination of strength of given HCl solution using a standard NaOH solution by performing a conductometric titration.	Analyse physical property of materials	Activity	1030.1	Class Quiz Mid Term I End Term
9.	Determination of strength of given CH_3COOH solution using a standard NaOH solution by performing a pH-metric titration.	Analyse physical property of materials	Activity	1030.1	Class Quiz Mid Term I End Term

10.	Determination of pK_{a1} and pK_{a2} of phosphoric acid.	Analyse physical property of materials	Activity	1001.3	Class Quiz Mid Term I End Term
11.	Titration of a mixture of strong acid HCl and weak acid CH_3COOH and determine the Determination of unknown strength of HCl and CH_3COOH pH-metrically	Analyse physical property of materials	Activity	1001.3	Class Quiz End Term
12.	the equivalent conductance of given an electrolyte	Analyse physical property of materials	Activity	1001.3	Class Quiz Mid Term I End Term
13.	Determination of the viscosity of a given lubricating oil at various temperatures using Redwood Viscometer No. 1 or No. 2. / Determination of cloud and pour point of a given sample of lubricating oil using cloud and pour point apparatus	Analyse physical property of materials	Activity	1001.3	Class Quiz Mid Term I End Term
14.	Demonstration of working of bomb calorimeter.	Analyse physical property of materials	Activity	1001.3	Class Quiz Mid Term I End Term

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

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CY 1030.1		2						3			2		2
CY 1030.2				2					2				3
CY 1030.3		2				3					3		2

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

MANIPAL UNIVERSITY JAIPUR

School of Electrical Electronics & Communication Engineering

Department of Electronics & Communication Engineering
Course Hand-out

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

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

A. Introduction:

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

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

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

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

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

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

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

[EC1001.5]. Demonstrate minimization of Boolean expressions

[EC1001.6]. Identify different elements of communication

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

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

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

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

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

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

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

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

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

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

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

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

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

D. Assessment Plan:

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

E. SYLLABUS

PN Junction: Formation of depletion region, Effect of forward and reverse bias on depletion region, I-V characteristics and equivalent circuits of ideal and practical diode, Diode equation. Application of Diode:

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

TEXT BOOKS

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

H. Lecture Plan:

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

16	Zener diode and its I-V characteristics	Understanding of voltage regulating device.	Lecture	EC1001.1 (CO 1)	In Class Quiz
17-18	Zener regulators	Understanding of voltage regulating circuits	Lecture	EC1001.1 (CO 1)	In Class Quiz Mid Term I End Term
19	Tutorial				
20	Introduction to BJT	Understanding of three terminal devices	Lecture	EC1001.2 (CO 2)	In Class Quiz
21	Operation of BJT	Understanding of minority carrier movement	Lecture	EC1001.2 (CO 2)	In Class Quiz
22	Transistor configuration: symbolic representation and CB Characteristics.	Characteristics of BJT under various config.	Lecture	EC1001.2 (CO 2)	In Class Quiz Mid Term II End Term
23	Transistor configuration: symbolic representation and CE Characteristics	Characteristics of BJT under various config.	Lecture	EC1001.2 (CO 2)	In Class Quiz Mid Term II End Term
24	CC configuration w.r.t. CE, Relation between α and β	Characteristics of BJT under various config.	Lecture	EC1001.2 (CO 2)	In Class Quiz Mid Term II End Term
25	Transistor Biasing, Q-point, Load line	Effect of load on the characteristics	Lecture	EC1001.2 (CO 2)	In Class Quiz Mid Term II End Term
26	Fixed biasing	Effect of load on the characteristics	Lecture	EC1001.2 (CO 2)	In Class Quiz Mid Term II End Term
27	Self-biasing	Effect of load on the characteristics	Lecture	EC1001.2 (CO 2)	In Class Quiz Mid Term II End Term
28	Introduction to Operational Amplifier, Op. Amp Characteristics.	Understanding the OPAMP characteristics and its difference from BJT as an amplifier.	Lecture	EC1001.3 (CO 3)	In Class Quiz
29	Inverting amplifier	Application of OPAMP	Lecture	EC1001.3 (CO 3)	In Class Quiz Mid Term II End Term
30	NON-Inverting amplifier, Linear applications of Op. Amp as voltage follower	Application of OPAMP	Lecture	EC1001.3 (CO 3)	In Class Quiz Mid Term II End Term
31	Summing amplifier, Subtractor	Application of OPAMP	Lecture	EC1001.3 (CO 3)	In Class Quiz Mid Term II End Term
32	Integrator, Differentiator	Application of OPAMP	Lecture	EC1001.3 (CO 3)	In Class Quiz Mid Term II End Term
33	Tutorial				
34	Digital Electronics: Number system	Mathematical understanding of Number System	Lecture	EC1001.4 (CO 4)	In Class Quiz

35	Boolean algebra, DeMorgan's theorem	Understanding the Algebra in Digital Electronics	Lecture	EC1001.5 (CO 5)	In Class Quiz End Term
36	Logic gates, Truth table.	Basic entities of Digital Electronics	Lecture	EC1001.5 (CO 5)	In Class Quiz End Term
37	Implementation of Boolean expression with logic gates	Use of Logic Gates to implement any Logic in Digital	Lecture	EC1001.5 (CO 5)	In Class Quiz End Term
38	SOP, POS forms	Understanding of various forms to represent a Logic	Lecture	EC1001.5 (CO 5)	In Class Quiz End Term
39	K-Map for minimization of Boolean expressions	A systematic way to minimize the given logic	Lecture	EC1001.5 (CO 5)	In Class Quiz End Term
40	S-R Flip Flop	Understanding of Basic Sequential Circuits	Lecture	EC1001.5 (CO 5)	In Class Quiz End Term
41	Introduction to communication system & Analog Modulation Scheme	Basic concept of Communication	Lecture	EC1001.6 (CO 6)	In Class Quiz End Term
42	Tutorial				

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

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

MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronics and Communication

Department of Electrical Engineering
Course Hand-out

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

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

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

a) To develop circuit designing skills through 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 transformer.
e) To understand the fundamentals of DC & Induction motors and measuring Instruments.

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

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

C. Program Outcomes and Program Specific Outcomes

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

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

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

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

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

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

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

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

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

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

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

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

D. Assessment Rubrics:

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

E. Syllabus

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

F. TEXT BOOKS

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

G. REFERENCE BOOKS

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

H. Lecture Plan:

Lec No	Topics	Session Outcomes	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
L1	Introduction to the Course	To acquaint students with the outcome based education (OBE) and Course outcome (CO) and program outcome (PO) assessment process	Lecture		NA
L2	Basic circuit elements, Source Transformation	Recall the basic elements of a DC network	Lecture	[1101.1]	Class Quiz
L3	Series & parallel resistive circuits, Review of Kirchhoff's laws	Identify different series and parallel network configurations and their equivalent resistance calculation	Lecture	[1101.1]	Home Assignment Class Quiz
L4-L5	Star-Delta transformation	Explain the need of star-delta transformation and their applications	Lecture	[1101.1]	Home Assignment Class Quiz
T1	L1 – L5	Numerical problems based on L1-L5	Tutorial	[1101.1]	Mid Term Exam
L6 – L7	DC Circuit Analysis – Mesh & Node analysis methods	Recall KVL and KCL and apply them to find solution of different dc network problems using Mesh & Node analysis methods	Lecture	[1101.1]	Mid Term Exam
T2-T3	L6 – L7	Numerical problems based on L6-L7	Tutorial	[1101.1]	Mid Term Exam
L8-L11	DC Network Theorems: Superposition, Thevenin, Norton, Maximum Power Transfer	Analyze and solve different dc network problems using all mentioned theorems	Lecture	[1101.1]	Home Assignment Class Quiz Mid Term Exam
T4-T5	L8-L11	Numerical problems based on L8-L11	Tutorial	[1101.1]	Mid Term Exam
L12	Capacitor, Series & Parallel connections, Charging & Discharging, Energy stored	Recall series and parallel connection of capacitors and energy stored	Lecture	[1101.2]	Class Quiz
L13	Inductor, Series & parallel connections, Growth & Decay of current in inductive circuit, Energy Stored	Recall series and parallel connection of inductors and energy stored	Lecture	[1101.2]	Class Quiz
T6	L12 – L13	Numerical problems based on L12-L13	Tutorial	[1101.2]	Class Quiz
L14–L15	Magnetic circuits, Terminologies, Analysis of series and parallel circuits	Recall the concept of magnetic circuits and their configurations	Lecture	[1101.2]	Class Quiz
L16	Review of Electromagnetism, Electromagnetic Induction, Fleming's left	Recall the Fleming's rule, Lenz's law, Faraday's law and review the concept of Electromagnetism	Lecture	[1101.2]	Class Quiz

	& right hand rules, Lenz's Law				
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 ac circuits	Lecture	[1101.3]	Class Quiz
L31-L32	Analysis of balanced 3 wire & 4 wire star and delta connected systems, Phasor diagrams	Analyze three phase balanced star and delta connected systems	Lecture	[1101.3]	Mid Term Exam
L33	Measurement of three phase power by two wattmeter method	Examine two wattmeter method for three phase power Measurement	Lecture	[1101.3]	Mid Term Exam
T12-T13	L29 – L33	Numerical problems based on L29-L33	Tutorial	[1101.3]	Class Quiz
L34	Single phase transformer: Introduction, types, Construction, Operating principle, Emf equation	Recall and analyse operating principle of Single phase transformer and their types	Lecture	[1101.4]	Class Quiz
L35 – L36	Ideal & practical transformer, Losses and Efficiency, Voltage regulation	Compare the ideal and practical transformer and analyse different performance parameters	Lecture	[1101.4]	Mid Term Exam
T14	L34 – L36	Numerical problems based on L34-L36	Tutorial	[1101.4]	Class Quiz

L37 - L38	Introduction of single and three phase induction motors	Describe the operating principle of single and three phase induction motors	Lecture	[1101.5]	Class Quiz
L39-L40	DC Machine: Introduction, Construction, Types	Describe the construction and operating principle of DC machine	Lecture	[1101.5]	Class Quiz
L41-L42	Fundamentals of Electrical Measuring Instruments	Describe the construction and operating principle of different Measuring Instruments	Lecture	[1101.5]	Class Quiz

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

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

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

MANIPAL UNIVERSITY JAIPUR

School of Humanities and Social Sciences

DEPARTMENT OF LANGUAGES

Course Hand-out

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

Session: July19-Nov 19 | Faculty: Dr Arun Kumar Poonia| Class: B-Tech I Semester

A. Introduction: This course is offered by the Department of Languages as a common course to the students of B. Tech in Semester-I/II. The course offers an in-depth knowledge of language as an important branch of English language studies. It covers basic concepts such as role of communication, vocabulary, comprehension, composition, and presentation skills. It also focuses on the enhancement of critical thinking, reasoning abilities, active listening, proper and appropriate writing skills in various practical situations.

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

[LN1001.1] Apply the fundamental principles of effective communication in day to day life as well as in the professional world.

[LN1001.2] Develop critical and creative thinking abilities for communicative competence

[LN1001.3] Organize and express ideas clearly in speech

[LN1001.4] Develop ideas with precision and coherence in writing

[LN1001.5] Utilize analytical communicative skills for effective presentations during employment opportunities and later on working in a team.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

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

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

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

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

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

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

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

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

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

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

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

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

D. Assessment Plan:

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

E. SYLLABUS

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

F. REFERENCES:

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

G. Lecture Plan:

DAY	TOPICS	Programme objective	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
Day 1	Introduction about the course hand-out/ Examination scheme/Internal Assessment and Communication skills.	Review communication as a process with greater awareness	Lecture, PPT, Discussion	1001.1	Quizzes, I Sessional, End Term Examination
Day 2 & 3	Definition, process, features, types, modes, and barriers	Display enhanced competence in oral communication	Lecture, PPT, Discussion	1001.1, 1001.2	Quizzes, I Sessional, End Term Examination
Day 4 & 5	LSRW Skills- Listening: Listening to groups and individuals- active listening, response, and feedback	Display enhanced competence in oral and written communication	Lecture, PPT, Discussion	1001.1, 1001.2	Quizzes, I Sessional, End Term Examination
Day 6	Comprehending conversations and lectures	Use appropriate co mmunication skills in specific	Lecture, PPT, Discussion	1001.1, 1001.2	Quizzes, I Sessional, End Term Examination

		contexts and for specific purposes			
Day 7& 8	**Reading:** Analysis of passages; skimming and scanning; contextual meaning	Use appropriate co mmunication skills in specific contexts and for specific purposes	Lecture, PPT, Discussion	1001.1, 1001.2	Quizzes, II Sessional, End Term Examination
Day 9	Advanced vocabulary	Demonstrate meaningful group communication exchanges	Lecture, PPT, Discussion	1001.2, 1001.3, 1001.4	Quizzes, II Sessional, End Term Examination
Day 10	**Writing**: Paragraph writing; Writing Creative and Critical responses	Develop critical and creative thinking abilities for communicative competence	Lecture, PPT, Discussion	1001.1, 1001.2, 1001.4	Quizzes, II Sessional, End Term Examination
Day 11 & 12	Formal letters; Emails	Develop critical and creative thinking abilities for communicative competence	Lecture, PPT, Discussion	1001.1, 1001.2, 1001.4	Quizzes, II Sessional, End Term Examination
Day 13 & 14	Resume and Statement of Purpose	Develop critical and creative thinking abilities for communicative competence	Lecture, PPT, Discussion	1001.1, 1001.2, 1001.4	Quizzes, II Sessional, End Term Examination
Day 15	**Speaking:** Presentation Skills and discussion.	Use appropriate co mmunication skills in	Lecture, PPT, Discussion	1001.1, 1001.2, 1001.3,	Quizzes, End Term Examination

		specific contexts and for specific purposes		1001.5	
Day 16-18	Debate on current affairs, scientific enquiry, philosophical attributions, literary sensibilities, socio-political awareness, and cultural sensitivity	Use appropriate co mmunication skills in specific contexts and for specific purposes	Lecture, Discussion and any case study	1001.1, 1001.2, 1001.3	Quizzes
Day 19	Telephonic Etiquettes	Use appropriate co mmunication skills in specific contexts and for specific purposes	Lecture, PPT, Discussion	1001.1, 1001.3	Quizzes, End Term Examination
Day 20 & 21	Role Play and Team Work	Use appropriate co mmunication skills in specific contexts and for specific purposes	Lecture, PPT, Discussion	1001.1, 1001.5	Quizzes
Day 22 & 23	Time Management and grooming	Develop critical and creative thinking abilities	Lecture and Discussion	1001.1, 1001.3, 1001.5	Quizzes
Day24-26	Exploring multiple perspectives- critical reasoning, constructive feedback, persuasive arguments	Develop critical and creative thinking abilities	Lecture, PPT, Discussion, any case study	1001.1, 1001.2, 1001.3	Quizzes
Day 27 & 28	Effective interpersonal communication	Use appropriate co mmunication skills in specific contexts and for specific purposes	Lecture, PPT, Discussion, any case study	1001.1, 1001.3, 1001.5	Quizzes

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

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

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

MANIPAL UNIVERSITY JAIPUR

School of Engineering

Department of Mathematics & Statistics
Course Hand-out

Engineering Mathematics-I | MA 1101 | 4 Credits | 3 1 0 4

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

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

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

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

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

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

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

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

C. Program Outcomes and Program Specific Outcomes

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

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

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

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

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

D. Assessment Rubrics:

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

E. Syllabus

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

F. Text Book:

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

G. Reference Book:

1. Kreyszig E., Advanced *Engineering Mathematics*, (10e), Wiley Eastern, 2011
2. Lay David C., *Linear Algebra and applications*, (3e), Pearson Education, 2009
3. Sastry S. S., *Introductory methods of Numerical analysis*, (4e), PHI, 2007
4. Iyengar S.R.K. and Jain, Rajendra K., *Advance Engineering Mathematics (3e)*, Narosa book distributors Pvt Ltd-New Delhi, 2007
5. Ramana B. V., *Higher Engineering Mathematics* (6th reprint), Tata Mcgraw-Hill, New Delhi, 2008

H. Lecture Plan:

Lecture No.	Description of the Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction: Basic definitions, solving first order differential equations using Variable separable method.	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.1	Quizzes, assignments, Two Sessional, End Term Examination
2	Homogeneous	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.1	Quizzes, assignments, Two Sessional, End Term Examination
3	reducible to Homogeneous	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.1	Quizzes, assignments, Two Sessional, End Term Examination
4	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	1101.1	Quizzes, assignments, Two Sessional, End Term Examination
5	Linear D. E	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.1	Quizzes, assignments, Two Sessional, End Term Examination
6	Bernouli equations	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.1	Quizzes, assignments, Two Sessional, End Term Examination
7	Solution of Exact differential equations	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.1	Quizzes, assignments, Two Sessional, End Term Examination
8	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	1101.1	Quizzes, assignments, Two Sessional, End Term Examination
9	Reducible to exact methods	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.1	Quizzes, assignments, Two Sessional, End Term Examination

10	higher order differetial equations - finding CF	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.1	Quizzes, assignments, Two Sessional, End Term Examination
11	Inverse differential operator method to calculate P.I for eax , sin (ax+b) and cos (ax+b)	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.1	Quizzes, assignments, Two Sessional, End Term Examination
12	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	1101.1	Quizzes, assignments, Two Sessional, End Term Examination
13	Inverse differential operator method to calculate P.I for xm, eax v	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.1	Quizzes, assignments, Two Sessional, End Term Examination
14	P.I using method of variation of parameters	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.1	Quizzes, assignments, Two Sessional, End Term Examination
15	Finite difference operators and relation among them.	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.2	Quizzes, assignments, Two Sessional, End Term Examination
16	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	1101.2	Quizzes, assignments, Two Sessional, End Term Examination
17	Newton-Gregory forward and backward interpolations	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.2	Quizzes, assignments, Two Sessional, End Term Examination
18	Stirlings formula	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.2	Quizzes, assignments, Two Sessional, End Term Examination
19	Lagrange's and inverse interpolation for unequal intervals.	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.2	Quizzes, assignments, Two Sessional, End Term Examination

20	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	1101.2	Quizzes, assignments, Two Sessional, End Term Examination
21	Numerical Differentiation - forward and backward formulas	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.2	Quizzes, assignments, Two Sessional, End Term Examination
22	Numerical Differentiation - Central formula	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.2	Quizzes, assignments, Two Sessional, End Term Examination
23	Numerical differentiation for unequal intervals	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.2	Quizzes, assignments, Two Sessional, End Term Examination
24	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	1101.2	Quizzes, assignments, Two Sessional, End Term Examination
25	Numerical Integration- Newton Cotes formula	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.2	Quizzes, assignments, Two Sessional, End Term Examination
26	Trapezoidal and Simpson's 1/3 rd rules of integration	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.2	Quizzes, assignments, Two Sessional, End Term Examination
27	Simpson's 3/8 th rule of integration,Weddle rule	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.2	Quizzes, assignments, Two Sessional, End Term Examination
28	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	1101.2	Quizzes, assignments, Two Sessional, End Term Examination
29	Solution of algebraic and transcendental equations : Bisection method	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.3	Quizzes, assignments, Two Sessional, End Term Examination

30	Regula –Falsi method	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.3	Quizzes, assignments, Two Sessional, End Term Examination
31	Solution by Newton Raphson's method	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.3	Quizzes, assignments, Two Sessional, End Term Examination
32	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	1101.3	Quizzes, assignments, Two Sessional, End Term Examination
33	Numerical solution of ordinary differential equations- by Taylor series method	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.3	Quizzes, assignments, Two Sessional, End Term Examination
34	Numerical solution of ordinary differential equations- by Euler 's method and modified Euler's method	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.3	Quizzes, assignments, Two Sessional, End Term Examination
35	Runge-Kutta method order 4	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.3	Quizzes, assignments, Two Sessional, End Term Examination
36	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	1101.3	Quizzes, assignments, Two Sessional, End Term Examination
37	Matrices and their properties, Elementary row transformations and Echelon matrix	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.4	Quizzes, assignments, Two Sessional, End Term Examination
38	Rank of the matrix with problems	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.4	Quizzes, assignments, Two Sessional, End Term Examination
39	Consistency of the system of homogeneous/non homogeneous equations: Solution by Gauss elimination	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	1101.4	Quizzes, assignments, Two Sessional, End Term Examination

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

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

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

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES											
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
MA1101.1	To describe the concept of ODE and their applications to solve the problems	3	3	1	3	1				2		2	1
MA1101.2	To describe the concept of Interpolation, Numerical differentiation & integration and their applications and in real life problems.	3	2	2	2	2				2		1	1
MA1101.3	To Describe the concept of numerical methods to evaluate the roots of Algebraic & Transcendental equations and solutions of ODE though which one could develop programming skills to develop the skill of solving the complex problems which intern become employable in corporate sector	3	2	2	2	2				3		3	1
MA1101.4	To Describe the concept of rank for the matrix by solution of the system of linear equations and developed the their skill to solve engineering application based problems.	3	3	2	3	2				1		2	1
MA1101.5	To Describe the basic concepts of vector space and to analysis the problems having engineering applications.	2	2	1	2	3				2		2	1

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Mechanical Engineering
Course Hand-out

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

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

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

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

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

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

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

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

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

C. Program Outcomes and Program Specific Outcomes

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

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

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

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

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

D. Assessment Rubrics:

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

E. Syllabus

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

F. Text Book:

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

G. Reference Book:

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

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

H. Lecture Plan:

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

14	Two stroke engines and Working of two stroke petrol engine, Working of two stroke diesel engine	Know the basics of the two S Engine and understand its applications	Lecture	ME1001.1 ME1001.2 ME1001.3	
15	comparison between petrol & diesel engines	Analyse the differences	Lecture	ME1001.2 ME1001.3	
16	Comparison between four stroke & two stroke engines and Important definitions	Analyse the differences	Lecture	ME1001.1 ME1001.2 ME1001.3	
17	Problems on I. C. Engines	Estimating the properties of IC Engine	Lecture/Activity	ME1001.2 ME1001.3	
18	**Lubrication:** Methods of lubrication, Splash & Force lubrication,	Know the basics of the lubrication and understand its applications	Lecture	ME1001.1	Class Quiz Mid-Term II End-Term
19	**Steam turbines** :definition, function, classification and comparison with steam engine	Know the basics of the steam turbine and understand its applications	Lecture	ME1001.1	
20	Impulse turbine - working principle and P – V diagram, Reaction turbine - working principle,	Understand the impulse and reaction turbine	Lecture	ME1001.1 ME1001.3	
21	Reaction Turbine-PV diagram (Continued),Difference between impulse & reaction turbine	Compare and understand the steam turbines	Lecture	ME1001.3	
22	**Power Transmission:** Introduction, Significance and definitions, Different methods of power transmission, types of belt drives,	Know the basics of power transmission and understand its applications	Lecture	ME1001.1	Class Quiz Mid-Term II End-Term
23	types of pulleys and its application, V – belt introduction and advantages	Know the type of belt and its use	Lecture	ME1001.1	
24	Derivation of length of belt (open and cross)	Estimate the length of belt drives	Lecture/Activity	ME1001.1	
25	Calculation of Velocity ratio for belt drive, introduction of slip and creep	Estimating the velocity ratio of belt drive	Lecture/Activity	ME1001.3 ME1001.5	
26	Calculation of Tension in belt drive (open), Power transmitted in belt drive and Numerical on belt drives	Estimating the tension in belt	Lecture/Activity	ME1001.3 ME1001.5	
27	Gear drives, types of gears and their application	Know the basics of the gear drives and understand its applications	Lecture	ME1001.1 ME1001.3 ME1001.5	
28	Calculation of velocity ratio for gear drive, gear train (simple and compound)	Estimating the velocity ratio of gear drive	Lecture	ME1001.3 ME1001.5	
29	**Machine tools**: Introduction **Lathe**- Basic introduction , explanation of principal parts of lathe with the help of diagram and working principle	Know the basics of the machine tool and understand its applications	Lecture	ME1001.1 ME1001.3 ME1001.5	Class Quiz End-Term

30	Specification of lathe Machine, Types of operations- Turning, Facing, Knurling, Parting, Grooving, Chamfering, taper turning	Analyse the Lathe Machine and its operation	Lecture	ME1001.1 ME1001.2 ME1001.3 ME1001.5	
31	**Drilling**: Introduction, classification of drilling machines, operations	Know the basics of the Drilling and understand its applications	Lecture	ME1001.1 ME1001.3	
32	Introduction to Shaper and Milling machine	Know the basics of the Milling and shaper and understand its applications	Lecture/ Workshop Visit	ME1001.1 ME1001.3	
33	**Foundry:** Usage of Foundry tools and equipments,	Know the basics of the Foundry and understand its applications	Lecture	ME1001.1 ME1001.3 ME1001.5	Class Quiz End-Term
34	Procedure of moulding process	Know the Procedure for moulding.	Lecture	ME1001.1 ME1001.2 ME1001.3 ME1001.5	
35	**Welding:** Definition, Classification majorly Gas and Arc welding,	Know the basics of the welding and understand its applications	Lecture	ME1001.1 ME1001.2 ME1001.3	
36	Principle of Oxy-Acetylene gas welding, flames and its application	Understand the gas welding	Lecture	ME1001.1 ME1001.2 ME1001.3 ME1001.5	
37	Principle of electric arc welding, Soldering and Brazing.	Understand the arc welding	Lecture	ME1001.1 ME1001.2 ME1001.3	
38	**Forging:** Definition, applications, tools Different Forging operations	Know the basics of the forging and understand its applications	Lecture/ workshop visit	ME1001.1 ME1001.2 ME1001.3 ME1001.5	

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

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile, Mechanical and Mechatronics

DEPARTMENT OF MECHANICAL ENGINEERING

Course Hand-out

Engineering Graphics| ME 1002 | 3 Credits | 0 0 6 3

Session: July – Nov 19 | Course Coordinator: Dr. Mithilesh Kumar Dikshit | Class: Regular

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:

[ME1002.1]. Students will be able to understand the conventions and the methods of engineering drawing.

[ME1002.2]. Students will be able to understand the theory of projections. Draw orthographic projections of lines, planes and solids.

[ME1002.3]. Students will learn to apply sectional views to most practically represent engineered parts**.** Students will have **skill** to prepare basic engineering models.

[ME1002.4]. Student will learn **design and drafting** in autocad. Understand the application of industry standards and techniques applied in engineering graphics.

C. Program Outcomes and Program Specific Outcomes

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

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

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

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

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

D. Assessment Plan:

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

E. Syllabus

Principle of Orthographic Projections: Points, straight lines parallel to one ref. plane (HP/VP) and inclined to other ref. plane; Straight lines inclined to both HP and VP; Straight lines inclined to both HP & VP and

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

F. Text Books:

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

G. Reference Books:

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

H. List of Sheets

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

CAD

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

I. Lecture Plan: Engineering Graphics [wrong format]

Lecture Number	Topics	Session Outcomes	Mode of delivery	**Corresponding CO**	Assessments
1	Introduction to Engineering Graphics	Layout of drawing sheet, conventions, scales, Dimensioning, Letterings and Numberings	Board/PPT	ME1002.1	Sheet performance in class/End terms
2	Theory of projection. Projection of Points	Types of Projections, orthographic projections, plane of projection, Quadrants, Angles of projections	Board/PPT	ME1002.1	
3	Problems on projection of points	Position of point, to find distance between any two points	Board/PPT	ME1002.1	
4	Projection of lines inclined to one plane and perpendicular to another plane	Position and projection of straight line, Methods for determining true length and true inclinations.	Board/PPT	ME1002.2	Sheet performance in class/End terms
5	Problems practice of lines inclined to one plane and parallel to other plane	Classroom practice.	Board/PPT	ME1002.2	
6	Projection and traces of straight line inclined to both planes	Projection of straight line inclined to both planes, determining apparent top view and apparent front view, angle of inclinations with both the planes.	Board/PPT	ME1002.2	
7	Problems practice on Lines inclined to both planes and traces of a line	Projection of straight line and traces.	Board/PPT	ME1002.2	
8	Projection of planes	Introduction to plane, location of plane, types of planes, Projection concepts	Board/PPT	ME1002.2	Sheet performance in class/End terms
9	Problems practice on projection of planes inclined to one plane and planes inclined to both planes	Projection of planes, perpendicular planes, plane inclined to reference planes	Board/PPT	ME1002.2	
10	Projection of Solids (right regular and by change of position method)	Introduction, types of solids, position of solids w.r.t. HP and VP	Board/PPT	ME1002.2	Sheet performance in class/End terms
11	Problems practice on projection of solids	Projection of solids in simple positions,	Board/PPT	ME1002.2	

		Position of solids in typical positions			
12	Problems on projection of solids inclined to both planes	Oblique solids, Frustum of cone and Pyramid, Truncated solids	Board/PPT	ME1002.2	
13	Problems on projection of solids	suspended freely and axis inclined to both planes, Axis inclined to both HP & VP, parallel to PP	Board/PPT	ME1002.2	
14	Problems on projection of solids	Projection of solids by auxiliary plane method; Axis inclined to both HP & VP	Board/PPT	ME1002.2	
15	Projection of sections of solids	Introduction, section of solids, Different terminology, classifications	Board/PPT	ME1002.3	Sheet performance in class/End terms
16	Projection of sections of solids	Section perpendicular to VP and parallel to HP, Section perpendicular to HP and parallel to VP	Board/PPT	ME1002.3	
17	Problems on projection of sections of solids	Section perpendicular to VP and inclined to HP, Section perpendicular to HP and inclined to VP	Board/PPT	ME1002.3	
18	Development of surfaces	Parallel line development, Radial line development and Triangular development	Board/PPT	ME1002.3	Sheet performance in class/End terms
19	Development of Surfaces	Problems on Development of Surfaces for prism, pyramid, cone cylinder	Board/PPT	ME1002.3	
20	Isometric view and projection	Introduction, Difference between isometric view and isometric projection, Isometric axis, isometric lines and isometric planes	Board/PPT	ME1002.3	Sheet performance in class/End terms
21	Problems on Isometric view and projection of planes and solids	Dimensioning on isometric projection Isometric view and projection of plane geometries, Four	Board/PPT	ME1002.3	

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

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

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

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Mechanical Engineering
Course Hand-out

Basic Workshop Practice| ME 1030 | 1 Credits

Session: JUL 19 – JUNE 20 | Faculty: Ashish Sharma

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

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

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

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

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

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

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

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

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

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

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

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

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

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

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

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

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

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

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

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

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

D. Assessment Plan:

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

E. SYLLABUS

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

F. TEXT BOOKS

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

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

G. Lecture Plan:

Lec No	**Topics**	**Session Outcome**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing the Outcome**
1	Study of parts of lathe machine and lathe operations	Understanding building of tools and lathe machines	Lecture+Lab	1030.1	Lab Experiment
2	Perform different operations on lathe machine like Facing, Turning, Taper Turning and knurling on MS cylindrical work piece	Performance of different operations	Lecture+Lab	1030.1	Lab Experiment
3	Study of types of welding process and perform welding of different types of joint on MS plate with arc welding process	Understanding of welding processes	Lecture+Lab	1030.2	Lab Experiment
4	Study of two stroke and four stroke engines.	Knowledge of IC engines	Lecture+Lab	1030.2	Lab Experiment
5	Layout of a small building plan on ground.	Understanding of building layout	Lecture+Lab	1030.3	Lab Experiment
6	Levelling around Academic block.	Have information regarding levelling	Lecture+Lab	1030.3	Lab Experiment
7	Measurement of tensile strength of reinforcement bar using UTM.	UTM experiment	Lecture+Lab	1030.4	Lab Experiment
8	Measurement of compressive strength of Brick/Cement by CTM.	CTM experiment	Lecture+Lab	1030.4	Lab Experiment
9	Designing of residential wiring and study of three phase induction motor.	Gain knowledge about residential wiring	Lecture+Lab	1030.5	Lab Experiment
10	Study of the working of fluorescent lamp and ceiling fan.	Study of lamp and ceiling fan	Lecture+Lab	1030.5	Lab Experiment

11	Use of electronic Instruments and tools.	Analyze the characteristics of different electronic components and its applications.	Lecture+Lab	1030.6	Lab Experiment
12	Building DC Regulated Power Supply.	Understanding of small circuits.	Lecture+Lab	1030.6	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
ME1030.1	Understanding about the various measuring, marking and cutting tools and Comprehend the safety measures required to be taken while using tools.	1				1		1		1			1
ME1030.2	Acquire skills and Knowledge about lathe machine, welding machines and 2S-4S engines and their operations.		1							1			
ME1030.3	Learn different techniques for quality assurance check of building materials.	1	1			1							1
ME1030.4	Analyse the profile of existing ground for any infrastructure development project	1				1				1			1
ME1030.5	Understand about the basic construction and working principle of fluorescent lamp, ceiling fan and three Phase Induction machine	1				1				1		1	1
ME1030.6	Analyze the characteristics of different electronic components and CRO.	1	1					1		1			1

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

MANIPAL UNIVERSITY JAIPUR
School of Basic Sciences

Department of Physics
Course Hand-out

Engineering Physics | PY1001 | 4 Credits | 3 1 0 4

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

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

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

[1001.1] identify clearly the wide range of diversity in science and technology with the help of knowledge of the basic Physics.
[1001.2] justify and explain various processes involved in understanding the nature of light.
[1001.3] categorize and investigate the problems and applications of quantum physics.
[1001.4] understand and relate the fundamentals of quantum mechanics and apply the skills to solve one dimensional motion of particles.
[1001.5] impart the knowledge of empirical laws based on Solid State Physics and Atomic and Molecular Physics.
[1001.6] develop skills in imparting practical knowledge to real time solution of industrial problems

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

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

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

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

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

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

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

D. Assessment Plan:

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

E. SYLLABUS

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

F. TEXT BOOKS

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

G. REFERENCE BOOK

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

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	**1001.1**	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	**1001.1 & 1001.2**	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	**1001.2**	Class Quiz – 1 Home Assignment - 1 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	**1001.2**	Class Quiz – 1 Home Assignment - 1 Mid Term I End Term
5	Interference in thin film, antireflection coatings	Understand the concept of thin-film interference	Lecture	**1001.2 & 1001.6**	Class Quiz – 1 Home Assignment - 1 Mid Term I End Term
6	TUTORIAL:1		Activity (Think Pair Share)		
7	Interference in wedge shaped air film	Understand the concept of interference in wedge shaped films and introduction to Newton's ring	Lecture	**1001.2 & 1001.6**	Class Quiz – 1 Home Assignment - 1 Mid Term I End Term
8	Newton's rings – theory and experiment	Describe the Newton's ring experiment and develop the theory of Newton's ring	Lecture	**1001.2**	Class Quiz – 1 Home Assignment-1 Mid Term I End Term

9	**TUTORIAL: 2**		Activity (Think Pair Share)		
10-11	Michelson interferometer – construction & theory (Qualitative approach only), Applications of Michelson interferometer (determination of wavelength)	Description of Michelson interferometer and derivation of the formula for determination of wavelength using it.	Lecture	**1001.2**	Class Quiz – 1 Home Assignment - 1 Mid Term I End Term
12	**TUTORIAL: 3**		Activity (Think Pair Share)		
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	**1001.2**	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	**1001.2**	Class Quiz – 2 Home Assignment - 2 Mid Term I End Term
17	**TUTORIAL:4**		Activity (Think Pair Share)	**1001.2**	
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	**1001.2**	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	**1001.2**	Class Quiz – 3 Home Assignment-2 Mid Term I End Term
20	**TUTORIAL:6**		Activity (Think Pair Share)	**1001.2**	
21	Rayleigh's criteria of resolution, Dispersion and	Understand the Raleigh's criteria for resolution and derive the expression for	Lecture	**1001.2**	Class Quiz – 3 Home Assignment-2 Mid Term I End Term

	resolving power of grating	dispersive and resolving power			
22	**TUTORIAL:7**		Activity (Think Pair Share)	**1001.2**	
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	**1001.2**	Class Quiz – 3 Home Assignment - 3 Mid Term I End Term
25	**TUTORIALS: 8**		Activity (Think Pair Share)	**1001.2**	
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	**1001.1 & 1001.3**	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	**1001.1 & 1001.3**	Class Quiz – 4 Home Assignment - 4 Mid Term II End Term
30	**TUTORIAL:9**		Activity (Think Pair Share)	**1001.3**	
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	**1001.1 & 1001.3**	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	Understand the Group Velocity and Phase Velocity and the concept of Uncertainty Principle	Flipped Classroom , Lecture	**1001.3**	Class Quiz – 5 Home Assignment - 5 Mid Term II End Term

	V_g & V_p in dispersive medium, Uncertainty Principle (Statement and expression only) and its Physical significance				
34	**TUTORIAL: 10**		Activity (Think Pair Share)	**1001.3**	
35	An Interpretation of Quantum mechanics, Wave function and its physical significance, SchrŐdinger wave equation	Introduction to wave function and Schrodinger wave equation	Lecture	**1001.3**	Class Quiz – 5 Home Assignment - 5 Mid Term II End Term
36	Particle in a box of infinite potential height	Derive the wave-function and energy of a particle confined in a one dimensional box	Lecture	**1001.3**	Class Quiz – 6 Home Assignment - 5 Mid Term II End Term
37	**TUTORIAL: 11**		Activity (Think Pair Share)	**1001.3**	
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	**1001.3**	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	**1001.1 & 1003.4**	Class Quiz – 6 Home Assignment - 5 Mid Term II End Term
41	**TUTORIAL: 12**		Activity (Think Pair Share)		
42-43	Bohr's Theory, Atomic Spectra of gases, Continuous and characteristic X-rays, Duane – Hunt relation, Moseley's law	Recall Bohr's theory and atomic spectra. Understand the continuous and characteristic X-rays and derive the related formula.	Flipped Classroom , Lecture	**1001.1 & 1001.4**	Class Quiz (Not Accounted) Home Assignment - 6 End Term
44-45	Energy states and spectra of molecules (	Qualitative discussion of Rotational and Vibrational	Lecture	**1001.4**	Class Quiz – 7 Home Assignment - 6

	Rotational and Vibrational spectra)	spectra and the related formulas			End Term
46	**TUTORIAL: 13**		Activity (Think Pair Share)		
47	Lasers- Spontaneous and stimulated transitions, Population inversion and metastable state,	Understand the lasers and the related optical phenomena.	Lecture	**1001.4 & 1001.5**	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	**1001.5**	Class Quiz – 7 End Term
50	**TUTORIAL: 14**		Activity (Think Pair Share)		
51	Band Theory of solids, Electrical conduction in Metals, Insulators, and Semiconductors	Understand qualitatively the band theory of solids	Lecture	**1001.5 & 1001.6**	Class Quiz – 8 End Term
52-53	Superconductivity: Type- I and Type- II Superconductivity, Meisner effect	Introduction to super conductivity and superconductors and the related phenomena	Lecture	**1001.5 & 1001.6**	Class Quiz – 8 End Term
54	**TUTORIAL: 15**		Activity (Think Pair Share)		
55	BCS Theory (Introductory) and Applications of superconductivity	Qualitatively understand the BCS theory and their applications	Lecture	**1001.5 & 1001.6**	Class Quiz – 8 End Term
56	**TUTORIAL: 16**		Activity (Think Pair Share)		

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

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

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

MANIPAL UNIVERSITY JAIPUR
School of Basic Sciences

Department of Physics
Course Hand-out

Engineering Physics Lab | PY1030 | 1 Credit | 0 0 2 1

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

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

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

[1030.1] clearly explain the different type of errors like backlash error, parallax etc.
[1030.2] assess the behaviour of basic instruments like Vernier Callipers, screw gauge, spherometer and spectrometer etc and it will enhance their skills to use them.
[1030.3] acquire, analyse and process experimental data.
[1030.4] compare and contrast the facts and ideas in handling the practical applications of light, electricity sound and modern physics.
[1030.5] acquire hands on skills on diverse experimental tools related to physics that are essential for engineering students

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

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

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

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

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

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

D. Assessment Plan:

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

E. SYLLABUS

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

F. TEXT BOOKS

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

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

G. Lecture Plan:

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

		Develop mathematical representation of waves.			
3	Experiments on diffraction and dispersion	Understanding of the concept of coherent waves and interference	Hands-on training	**1030.2 & 1030.3**	Continuous Assessment/Viva
4	experiments on quantum theory of radiation	Derivation of the formula for intensity distribution in double slit interference	Hands-on training	**1030.2 & 1030.3**	Continuous Assessment/Viva
5	Experiments on band theory of solids	Understand the concept of thin-film interference	Hands-on training	**1030.3 & 1030.4**	Continuous Assessment/Viva
6	Experiments on semiconductors		Hands-on training	**1030.3, 1030.4 & 1030.5**	Continuous Assessment/Viva
7	Experiments on resonance circuits	Understand the concept of interference in wedge shaped films and introduction to Newton's ring	Hands-on training	**1030.3, 1030.4 & 1030.5**	Continuous Assessment/Viva
8	Experiments on Hall-effect		Hands-on training	**1030.3 & 1030.4**	Continuous Assessment/Viva

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

CO	**STATEMENT**	CORRELATION WITH PROGRAM OUTCOMES															
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12				
PY 1030.1	understand different type of error like backlash error, parallax etc. and its role in making conclusions.	3	3		1	2	1			3	1		1				
PY 1030.2	gain knowledge on the behaviour of basic instruments like Slide Callipers, Vernier Callipers, screw gauge and spherometer etc.	3	2		2	2				1	2		1				
PY 1030.3	acquire, analyse and process experimental data.	1	1	1			3	2		1	2	1	2				
PY 1030.4	understand the facts and ideas in handling the practical applications of light, electricity				1	2			2	2	1		1				

	sound and modern physics.																
PY 1030.5	acquire hands on skills on diverse experimental tools related to physics that are essential for engineering students	1	3	1				3				2					

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile, Mechanical & Mechatronics

Department of Automobile Engineering
Course Hand-out

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

Session: July 19 – November 19 | Faculty: Dr Poonam Mishra | Class: B. Tech Semester III

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

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

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

C. Program Outcomes and Program Specific Outcomes

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

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

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

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

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

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

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

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

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

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

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

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

D. Assessment Plan:

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

E. SYLLABUS

Definition, nature and scope of economics; Introduction to micro and macroeconomics; law of demand and supply; elasticity of demand and supply; cardinal and ordinal approaches of utility; production, laws of production; cost and revenue analysis; various market situations; Break even analysis; Capital budgeting Macro Economics: National

income and its concepts, value of money and its changes; foreign exchange rate; monetary and fiscal policies and other macro concepts (Balance of payments, Business cycles etc.)

F. TEXT BOOKS

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

G. REFERENCE BOOKS

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

H. Lecture Plan:

Lec No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Overview of the course structure	To acquaint and clear the overview of the course	Lecture	NA	NA
2	Objective of the course	Discussion of the objective of the course for the engineers	Lecture	NA	NA
3,4	Definition, nature and scope of economics, introduction to micro and macroeconomics	Describe the concept given by different economists, its scope, differences between micro and macro economics	Lecture	1323.1	Class Test Mid Term I
5,6,7,	Cardinal approaches of utility	Describe the concept of cardinal approach of utility, Law of DMU and equi marginal utility	Lecture	1323.1	Class Test Mid Term I
8,9,10,11	Law of demand and supply, elasticity of demand and supply	Describe the concept of demand, supply, elasticity of demand and supply with examples, conceptual questions	Lecture	1323.1	Class Test Mid Term I
12	Revision of previous lectures	Recall all the concepts discussed in previous classes	Lecture	1323.5	Class Test Mid Term I End Term
13	Discussion of the topics related to assignment	Discussion about the assignment topics	Lecture, Activity		Home Assignment Mid Term 1 End term
14,15,16	Ordinal approaches of utility	Recall of the differences between the concept of the cardinal approach and ordinal approach of utility , IC analysis, Consumers equilibrium, IE,SE,PE	Lecture	1323.5	Class Test Mid Term I End Term
17,18,19	Production, laws of production	Discussion of the concept of production, recognize production function, producers equilibrium, RTS	Lecture	1323.4	Class Test Mid Term II End Term
20,21	Cost and revenue analysis	Discussion of the concept of cost and cost function, recognize SR and LR cost curves, revenues	Lecture	1323.4	Class Test Mid Term II End Term
22,23	Various market situations; Break even analysis	Aware of market morphology with examples, Interpret and illustrate BEA	Lecture	1323.3	Class Test Mid Term II End Term
24	Revision of previous lectures	Recall all the concepts discussed in previous classes	Lecture	1323.5	Class Test Mid Term II End Term

25	Discussion of the topics related to assignment	Recall the discussion about the assignment topics	Lecture, Activity	1323.5	Home Assignment Mid Term II End term
26	Capital budgeting	Interpret and illustrate the concept of CB and various tools	Lecture	1323.2	Home Assignment Class Test End Term
27,28	Macro Economics: National income and its concepts	Interpret and illustrate the concept of NI,GDP,GNI,PI etc., circular flow	Lecture	1323.2	Home Assignment Class Test End Term
31,32,33	Monetary and fiscal policies	Concept of monetary and fiscal policies, Aware of its instruments, importance and limitations	Lecture	1323.3	Home Assignment Class Test End Term
34,35	Inflation	Concept of inflation, Aware of demand pull and cost push inflation	Lecture	1323.3	Home Assignment Class Test End Term
36,37	Various macro concepts: Balance of payments, Business cycles	Aware of the concept of BOP, Business cycles	Lecture	1323.3	Home Assignment Class Test End Term
38	Discussion of the topics related to end sessional examination	Recall the discussion about the assignment topics	Lecture	1323.5	End Term
39	Conclusion and Course Summarization	Recall all the concepts discussed in previous classes	Lecture	1323.5	End Term

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

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EO 1323.1	Describe the basic principles of micro and macroeconomic analysis									1		2	2			
EO 1323.2	Interpret and illustrate decision making process in practical life						1			2			2			
EO 1323.3	Aware of the tools and techniques of economics for real world									2		2	2			
EO 1323.4	Recognize the problems and give solutions to it									2		2	2			
EO 1323.5	Recall the assumptions that underpin the Micro/Macro model.									2			3			

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

MANIPAL UNIVERSITY JAIPUR

DEPARTMENT OF AUTOMOBILE ENGINEERING

Department of Mathematics and Statistics Course Hand-out

Engineering Mathematics III | MA 1313 | 3 Credits

Session: July19-December 19 | Faculty: Dr. Sunil Joshi

A. **Introduction:** This course is offered by Dept. of Mathematics as core subject, targeting students who wish to pursue research& development in industries or higher studies in field of Engineering Mathematics. Offers in depth knowledge Laplace and Fourier transform, Numerical analysis, Fourier series and vector calculus. Students are expected to have background knowledge on integration and differentiation for a better learning.

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

[1313.1] Describe the concept of Laplace Transform & their properties to apply in real world problems which enhance their analytical skills in solving the related problems in engineering.

[1313.2] Describe the problems of engineering by using Numerical analysis.

[1313.3] Describe the concepts and properties of gradient, divergence and curl to formulate engineering problems and convert line integrals into area integrals and surface integrals into volume integrals by using suitable theorems.

[1313.4] Describe the concept and properties of periodic functions by Fourier series and apply them to evaluate the related problems.

[1313.5] Describe the concepts of the Fourier transforms and apply them to solve problems arising in Engineering, which increase the employability in the related field.

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]. Autotronics and Electric Vehicle Technology: Apply knowledge of electrical and electronics engineering for providing automobile engineering solutions

[PSO.2]. Alignment to Super Qualification packs of ASDC: Demonstrate knowledge and performance criteria as defined by ASDC super qualification packs for R&D or Quality or Service Engineering

[PSO.3]. Application of Lean Six Sigma Methodology: Demonstrate through an internship project, the knowledge and understanding of lean six sigma methodology based on Define, Measure, analyse, improve/develop and control/validate phases (DMAIC/ DMADV).

D. Assessment Plan:

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

E. SYLLABUS

Vector Calculus: gradient, divergence and curl, vector integrals, related theorems

Laplace Transforms: Transforms of elementary functions, inverse transforms, convolution theorem. Application of Laplace in solutions of differential equations with constant coefficients.

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

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

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

F. Text Books:

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

G. References:

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

H. Lecture Plan:

S.No.	TOPICS	Session Outcome	Mode of Delivery	Corresponding CO	Mode of assessing the outcome
		Laplace Transform:			
1	Introduction and Course Hand-out briefing : Definition of LT. LT of elementary functions.	Understanding the basics of Integral Transform & Laplace Transform	Lecture	MA1313.1	MTE-I Assignment & Quiz Test ETE
2-4	Properties of LT: linearity, First shifting, second shifting, change of scale, Multiplication by t, division by t, Derivative property, Integral Property ,Initial Value Problem, Final Value Problem (Without Proof)	Describe various properties of Laplace Transform	Lecture	MA1313.1	MTE-I Assignment & Quiz Test ETE
5-6	Inverse transforms, convolution theorem.	Discuss Inverse laplace Transform with theorems	Lecture	MA1313.1	MTE-I Assignment & Quiz Test ETE
7	Application of Laplace in solutions of differential equations with constant coefficients.	Application of Laplace Transform in solving differential equations	Lecture	MA1313.1	MTE-I Assignment & Quiz Test ETE
		Finite Differences and Interpolation			
8	Introduction of Numerical Analysis: Finite difference operators	Describe Finite difference operators	Lecture	MA1313.2	MTE-I Assignment & Quiz Test ETE
9-10	Newton's- Gregory forward and backword interpolation formula,	Describe forward and Backward interpolation formula	Lecture	MA1313.2	MTE-I Assignment & Quiz Test ETE
11-12	Stirling interpolation & Lagrange's	Describe central difference formula and formula for unequal intervals	Lecture	MA1313.2	MTE-II Assignment & Quiz Test ETE
13-14	Numerical Differentiation (For Forward, Backward, Stirling)	Discuss Numerical differentiation	Lecture	MA1313.2	MTE-II Assignment & Quiz Test ETE
15-17	Numerical Integration(Quadrature formula, Trapezoidal rule, Simpson 1/3rule, Simpson's 3/8 rule, Weddle rule	Describe numerical Integration	Lecture	MA1313.2	MTE-II Assignment & Quiz Test ETE
		Vector Calculus:			

18-20	gradient, divergence and curl	Describe Basics of Vector calculus	Lecture	MA1313.3	MTE-II Assignment & Quiz Test ETE
21-23	vector integrals	Describe Vector integrals	Lecture	MA1313.3	MTE-II Assignment & Quiz Test ETE

24-27	Greens, Stokes and Gauss Divergence theorem	Discuss various theorems of vector calculus and their properties	Lecture	MA1313.3	MTE-II Assignment & Quiz Test ETE
Fourier series:					
28-29	Fourier series, Dirichlet Condition	Explain properties and basics of fourier Series	Lecture	MA1313.4	MTE-II Assignment & Quiz Test ETE
30	even and odd functions half range series	Describe series of even and odd functions	Lecture	MA1313.4	MTE-II Assignment & Quiz Test ETE
31	change of interval	Describe fourier series for change of interval	Lecture	MA1313.4	ETE Assignment & Quiz Test
32-33	Harmonic analysis	Describe Harmonic analysis	Lecture	MA1313.4	ETE Assignment & Quiz Test
Fourier Transforms:					
34	Fourier integrals	Describe basics of Fourier Transform and fourier integrals	Lecture	MA1313.5	ETE Assignment & Quiz Test
35-36	Complex Fourier transform, Fourier sine and cosine transforms,	Describe Fourier sine & cosine transform	Lecture	MA1313.5	ETE Assignment & Quiz Test
37-38	Properties of Fourier Transform	Describe Properties of Fourier Transform	Lecture	MA1313.5	ETE Assignment & Quiz Test
39-40	solution of heat and wave equations	Describe Application of Fourier Transform	Lecture	MA1313.5	ETE Assignment & Quiz Test
END SEMESTER EXAMINATION					

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
MA 1313.1	Describe the concept of Laplace Transform & their properties to apply in real world problems which enhance their analytical skills in solving the related problems in engineering.	2	2	1	1								1			
MA 1313.2	Describe the problems of engineering by using Numerical analysis.	3	2								2		1			
MA 1313.3	Describe the concepts and properties of gradient, divergence and curl to formulate engineering problems and convert line integrals into area integrals and surface integrals into volume integrals by using suitable theorems.	2	2	1		2							1			
MA 1313.4	Describe the concept and properties of periodic functions by Fourier series and apply them to evaluate the related problems.	2	2								1		1			
MA 1313.5	Describe the concepts of the Fourier transforms and apply them to solve problems arising in Engineering, which increase the employability in the related field.	2	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 Automobile Engineering
Course Hand-out

Material Science and Metallurgy | AU 1302 | 3 Credits | 3 0 0 3

Session: July'19 – Dec'19 | Course Coordinator: Dr. Vinod Yadav | Class: 2nd Year / 3rd Semester

Faculty: Dr. Vinod Yadav

A. Introduction: This course is offered by Department of Automobile Engineering as a core course to provide a better understanding of different engineering materials. This course is one of the basic course for any branch of engineering students to understand behaviour of materials and transformation of microstructure in different temperature zone. This course provides an automobile engineering student to get proper idea of different material properties which is make use during fabricating vehicle. This course also helps our students during participation of different levels of car team competition such as SAE-BAJA, SAE-SUPRA, SAE- EFFICYCLE etc.

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

[1302.1]. Understand various crystal structure of materials and analyse different mechanism of plastic deformation of metal and alloys.
[1302.2]. Analyse the mechanisms of strengthening engineering materials.
[1302.3]. Construct various phase diagrams for metal alloys.
[1302.4]. Understand different heat treatment process and recommend suitable process based on the material properties required to improve skills.
[1302.5]. Explain the features and applications of engineering materials including traditional and newer materials like composite and smart materials.

C. Program Outcomes and Program Specific Outcomes

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

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

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

[PSO.1]. Autotronics and Electric Vehicle Technology: Apply_knowledge of electrical and electronics engineering for providing automobile engineering solutions

[PSO.2]. Alignment to Super Qualification packs of ASDC: Demonstrate knowledge and performance criteria as defined by ASDC super qualification packs for R&D or Quality or Service Engineering

[PSO.3]. Application of Lean Six Sigma Methodology: Demonstrate through an internship project, the knowledge and understanding of lean six sigma methodology based on Define, Measure, analyse, improve/develop and control/validate phases (DMAIC/ DMADV).

D. Assessment Rubrics:

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

E. Syllabus

Introduction: Materials classification, Crystallography, Miller indices: Miller Bravais indices, Crystal structure determination, **Imperfections in Crystals:** Point defects, Line defects, Surface defects, **Plastic Deformation**: Metals and Alloys, Dislocation, Slip and twinning, Schmids law, **Strengthening mechanisms**: Solid solution strengthening, Work hardening, Recovery recrystallization and grain growth, **Diffusion:** Steady state and non-steady state diffusion, **Solidification of Metals and Alloys**: Solid solution, Hume Rothery's rules, **Phase diagrams** Phase and Lever Rules relationship of micro Structure and properties, Isomorphs systems, Eutectic system, Eutectoid peritectoid reactions, **Iron- Carbon equilibrium diagram**, Development of microstructure in Iron Carbon alloys, Phase transformation in steel, **Heat Treatment** ,TTT diagram, **Steel:** Low, medium, and high carbon steels, Stainless steels-ferritic, Austenitic, Martensitic, Duplex steels, Tool steels, Aluminium and its alloys, Magnesium and alloys, Titanium and its alloys, **Ceramics and other materials:** Super alloys, ceramics, Refractories, Composites and glasses, Nano-materials.

F. Text Books

T1. *V. Raghavan, Material Science and Engineering, Prentice Hall of India Ltd., 4th Edition, 1994.*

T2. *William D. Callister , "Materials Science and Engineering", John Wiley & Sons Inc. 2010*

T3. *R. K. Rajput, Material Science and Engineering, S. K. Kataria & Sons, Re Print - 2009 Edition.*

G. REFERENCE BOOKS

R1. *Er. Amandeep Singh Wadhwa and Er. Harvinder Singh Dhaliwal, A Text book of Engineering Material and Metallurgy, University Science Press, Reprint 2011 Edition.*

R2. *O. P. Khanna, A Text book of Material Science and Metallurgy, Dhanpat Rai Publications, Reprint 2011 Edition.*

R3. *V. D. Kodgire and S. V. Kodgire, Material Science and Metallurgy for Engineers, Everest Publishing House, 31st Edition, 2012.*

R4. *E. Dieter, Mechanical Metallurgy, Metric Editions, McGraw Hill Book Company.*

R5. *S. P. Nayak, Engineering Metallurgy and Material Science, Charoter Publishing House, 6th Edition, 1995.*

H. Lecture Plan:

Lecture	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction	To create an understanding between students and teacher	Flipped Classroom	1302.1	NA
2	Course objective and outcomes	To acquaint and clear teachers expectations and understand student expectations	Lecture	NA	NA
3	**Introduction:** Material	Describe the concept of material used in history.	Lecture	1302.1	Class Quiz
4	Material Classification	Distinguee engineering material and how these materials are used in automobile industry?	Flipped Classroom Lecture	1302.1	Sessional Exam End Term Exam
5	Crystallography	Describe the difference in atomic/molecular structure between crystalline and non-crystalline materials.	Flipped Classroom Lecture	1302.1	Class Quiz Sessional Exam End Term Exam Home Assignment
6-7	Miller indices	Specify miller indices for a plane that has been drawn within a unit cell Sketch direction corresponding to miller indices within a unit cell.	Lecture Flipped Classroom	1302.1	Class Quiz Sessional Exam End Term Exam
8	Miller Bravais indices	Determination of miller bravais indices for a plane within a different unit cell.	Lecture	1302.1	Sessional Exam End Term Exam Class Quiz
9	Crystal structure determination	Analysis atomic and molecular arrangement in solid crystal structure.	Lecture	1302.1	Sessional Exam End Term Exam
10	**Imperfections in Crystals:** Introduction	Describe effect of imperfection on crystal structure.	Lecture	1302.1	Class Quiz Sessional Exam End Term Exam
11	Point defects, Line defects, Surface defects	Differentiate among different types of defects.	Lecture Flipped Classroom	1302.1	Sessional Exam End Term Exam
12	Plastic Deformation, Metals and Alloys	Analysis plastic deformation of metal as well as alloys.	Lecture Flipped Classroom	1302.1	Home Assignment Class Quiz Sessional Exam End Term Exam

13	Dislocation, Slip and twinning	Examine each of edge, screw and mixed dislocation by • Describing and make a drawing of dislocation • Note the location of the dislocation line • Indicate the direction along which dislocation line extended.	Lecture Flipped Classroom	1302.2	Home Assignment Sessional Exam End Term Exam Class Quiz
14	Schmids law	Describe the effect of slip plane and slip direction on crystal structure.	Lecture	1302.2	Sessional Exam End Term Exam
15-17	Strengthening mechanisms: Solid solution strengthening, Work hardening, Recovery recrystallization and grain growth	Examine different method of strengthening mechanism. Analysis variation of recovery recrystallization and grain growth with respect to mechanical properties.	Lecture Flipped Classroom	1302.2	Home Assignment Sessional Exam End Term Exam Class Quiz
18-19	**Diffusion:** Steady state and non-steady state diffusion	Describe the atomic mechanism of diffusion in metallic, ionic and polymer materials. Compute diffusion coefficient for some material at a specified temperature, given the appropriate diffusion constants.	Flipped Classroom Lecture	1302.2	Sessional Exam End Term Exam Class Quiz Home Assignment
20	**Solidification of Metals and Alloys:** Introduction	Express solidification effect on metal and alloys.	Lecture	1302.3	Sessional Exam End Term Exam
21	Solid solution, Hume Rothery's rules	Describe the conditions under which an element could dissolve in a metal, forming a solid solution.	Lecture	1302.3	Class Quiz Sessional Exam End Term Exam
22-23	Phase diagrams Phase and Lever Rules relationship of micro Structure and properties	Analysis the effect on microstructure on varying temperature and alloy composition	Lecture Flipped Classroom	1302.3	Sessional Exam End Term Exam Class Quiz
24	Isomorphs systems, Eutectic system, Eutectoid peritectoid reactions	Differentiate among eutectic system, eutectoid system and peritectoid system.	Lecture Flipped Classroom	1302.3	Sessional Exam End Term Exam Class Quiz
25-26	Iron- Carbon equilibrium diagram	Sketch Iron - Carbon equilibrium diagram and describe each part of sketch.	Flipped Classroom	1302.3	Class Quiz Sessional Exam End Term Exam
27	Development of microstructure in Iron Carbon alloys	Analysis the effect on mechanical behaviour in development of microstructure in Iron Carbon alloys	Flipped Classroom	1302.3	Class Quiz Sessional Exam End Term Exam
28	Phase transformation in steel	Describe microstructure for each of the micro constituents that are found in steel alloys.	Lecture	1302.3	Sessional Exam End Term Exam Class Quiz

29-32	Heat Treatment	Explain different types of heat treatment processes. Analysis the effect of heat treatment processes in automotive components.	Lecture Flipped Classroom	1302.4	Class Quiz Sessional Exam End Term Exam
33-34	TTT diagram	Compare the effect of temperature and time in changing microstructure of alpha iron.	Lecture Flipped Classroom	1302.4	Class Quiz Sessional Exam End Term Exam
35	**Steel:** Low, medium, and high carbon steels	Categories different types of steel on the basic of % composition of carbon.	Lecture Flipped Classroom	1302.5	Class Quiz Sessional Exam End Term Exam
36	Stainless steels-ferritic, Austenitic, Martensitic	Compare stainless steel and normal steel in terms of composition and application.	Lecture Flipped Classroom	1302.5	Sessional Exam End Term Exam Class Quiz
	Duplex steels, Tool steels	Investigate special type of characteristics of tool steel.	Lecture Flipped Classroom	1302.5	Class Quiz Sessional Exam End Term Exam Home Assignment
37	Aluminium and its alloys	Explain use of aluminium and its alloys in automobile industry.	Lecture Flipped Classroom	1302.5	Class Quiz Sessional Exam End Term Exam Home Assignment
	Magnesium and alloys	Explain use of magnesium and its alloys in automobile industry.	Lecture Flipped Classroom	1302.5	Class Quiz Sessional Exam End Term Exam Home Assignment
38	Titanium and its alloys	Explain use of titanium and its alloys in automobile industry.	Lecture Flipped Classroom	1302.5	Class Quiz Sessional Exam End Term Exam Home Assignment
39	**Ceramics and other materials:** ceramics, Refractories	Express ceramics and refractories material in automobile industry.	Lecture	1302.5	Sessional Exam End Term Exam Home Assignment
40	Super alloys	Express different super alloys used in automobiles.	Lecture	1302.5	Sessional Exam End Term Exam Home Assignment
41	Composites and glasses	Compare composite material and glasses in terms of composition and application.	Lecture Flipped Classroom	1302.5	Sessional Exam End Term Exam Home Assignment
42	Nano-materials	Differentiate different types of non-material used in automobiles.	Lecture Flipped Classroom	1302.5	Sessional Exam End Term Exam Home Assignment

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
AU 1302.1	Understand various crystal structure of materials and analyse different mechanism of plastic deformation of metal and alloys.	**3**													**2**	
AU 1302.2	Analyse the mechanisms of strengthening engineering materials.	**2**					**1**								**2**	
AU 1302.3	Construct various phase diagrams for metal alloys.	**1**													**2**	
AU 1302.4	Understand different heat treatment process and recommend suitable process based on the material properties required.	**1**		**2**			**1**						**1**		**2**	
AU 1302.5	Explain the features and applications of engineering materials including traditional and newer materials like composite and smart materials.	**1**		**2**			**3**	**2**					**1**	**1**	**2**	

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Automobile Engineering
Course Hand-out

Strength of Materials| AU 1305 | 4 Credits | 3 0 2 4

Session: July 19 – Nov 19 | Faculty: Ashu Yadav | Class: II Year III Semester

A. Introduction: This course is offered as a core course to the students of II Year B. Tech Automobile Engineering. Offers in-depth knowledge on various parameters like stress, strain, Shear force, bending moment etc. which are directly associated with material strength, that a student will utilize for designing and testing of automobile structures in the future. This course is supplemented with automobile design in the future semester.

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

[1305.1]. Analyse and design structural members subjected to tension, compression, torsion, bending and combined stresses using the fundamental concept of stress, strain and elastic behaviour of materials to improve employability skills.

[1305.2]. Estimate principal stresses & strains under different loading conditions.

[1305.3]. Compute SFD & BMD, slope & deflection for different type of beams under given constraints.

[1305.4]. Estimate bending stress and shear stress distribution in different cross sections.

[1305.5]. Determine failure of column and strut by analysing different end conditions.

C. Program Outcomes and Program Specific Outcomes

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

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

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

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

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

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

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

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

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

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

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

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

[PSO.1]. Autotronics and Electric Vehicle Technology: Apply_knowledge of electrical and electronics engineering for providing automobile engineering solutions

[PSO.2]. Alignment to Super Qualification packs of ASDC: Demonstrate knowledge and performance criteria as defined by ASDC super qualification packs for R&D or Quality or Service Engineering

[PSO.3]. Application of Lean Six Sigma Methodology: Demonstrate through an internship project, the knowledge and understanding of lean six sigma methodology based on Define, Measure, analyse, improve/develop and control/validate phases (DMAIC/ DMADV).

D. Assessment Rubrics:

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)	10
	Practical Internal	15
	End Term Exam	40
End Term Exam (Summative)	Practical External	05
	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

Stresses & Strains: Overview of simple stresses and strains. **Shear Force and Bending Moment:** Bending moment and shear force diagrams for different types of static loading and support conditions on beams. **Strain Energy:** Strain energy due to various types of loading, Strain energy due to self-weight, Strain energy due to shear force, Strain energy in terms of principal stresses. **Pure bending and Shear stress in beam:** Theory of simple bending, bending stresses, section modulus and transverse shear stress distribution in circular, hollow circular, I, Box, T, angle sections etc. Combined Direct and Bending Stress **Torsion:** Torsional shear stress in solid, hollow and stepped circular shafts, angular deflection and power transmission capacity, Strain energy in torsion. **Principal Planes, Stresses and Strains:** Members subjected to combined axial, bending and torsional loads, maximum normal and shear stresses, concept of equivalent bending and equivalent twisting moments, Mohr's circle of stress and strain. **Column and strut:** Instability and elastic stability, long and short columns, ideal strut, Euler's formula for crippling load for columns of different ends, concept of equivalent length, eccentric loading, Rankine formulae and other empirical relations. **Deflection of Beam:** Elastic curve of neutral axis of the beam under normal loads, Beam deflection and slope, Relation between deflection, bending moment, shear force and load, transverse deflection of beams and shaft under static loading.

Lab: Tension test on mild steel, Compression test on cast iron, Hardness tests, Rockwell hardness, Brinell's hardness, Charpy Impact test, Izod test on mild steel, Shear test, Torsion test on mild steel, Fatigue test on mild steel, Test on leaf spring, Test on Helical spring, Bending Test on Wood, Compression test on wood.

F. TEXT BOOKS

a. E.P. Popov, Engineering Mechanics of Solids, Prentice-Hall of India, New Delhi, 1997.

b. F.P. Beer and R. Johnston Mechanics of Materials, McGraw-Hill Book Co, Third Edition, 2002.

G. REFERENCE BOOKS

R1. W.A. Nash, Theory and problems in Strength of Materials, Schaum Outline Series, McGraw-Hill Book Co, New York, 1995.

R2. S.M.A. Kazimi, Solid Mechanics, Tata McGraw-Hill Publishing Co, New Delhi, 1981.

H. Lecture Plan:

Lecture	Topics	Session Objective	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction	To acquaint and clear teachers expectations and understand student expectations	Lecture	NA	NA
2	Assumption consider in Strength of materials	Understand the limitations of the courses	Lecture	1	In class quiz
3	Overview of simple stresses and strains	Recalling stresses and strains	Lecture/Flipped Classroom	1	In class quiz Mid Term End Term
4	Overview of simple stresses and strains	Recalling different relationship between stress and strain	Lecture/Flipped Classroom	1	In class quiz Mid Term End Term
5	Overview of simple stresses and strains	Recalling different relationship between stress and strain	Lecture/Flipped Classroom	1	Home Assignment Mid Term End Term
6	Introduction shear force and Bending Moment, types of support, types of load	Explain shear force and Bending Moment, types of support, types of load.	Lecture	3	In class quiz Mid Term End Term
7	Shear force and bending moment diagram for Simply supported beam	Draw Shear force and bending moment diagram for Simply supported beam by analysing loading conditions.	Lecture/Flipped Classroom	3	In class quiz Home Assignment Mid Term End Term
8	Shear force and bending moment diagram for cantilever beam	Draw Shear force and bending moment diagram for cantilever beam by analysing loading conditions.	Lecture/Flipped Classroom	3	In class quiz Home Assignment Mid Term End Term
9	Shear force and bending moment diagram for overhanging beam	Draw Shear force and bending moment diagram for overhanging beam by analysing loading conditions.	Lecture/Flipped Classroom	3	Home Assignment Mid Term End Term
10	Strain energy	Estimate Strain energy due to various types of loading, Strain energy due to self-weight	Lecture	1	In class quiz Mid Term End Term
11	Strain energy	Estimate Strain energy due to various types of loading, Strain energy due to self-weight	Lecture	1	In class quiz Mid Term End Term
12	Strain energy	Estimate Strain energy due to shear force	Lecture/Flipped Classroom	1	In class quiz Mid Term End Term
13	Theory of simple bending, bending stresses, section modulus	Explain theory of simple bending, bending stresses, section modulus	Lecture	4	In class quiz Mid Term End Term
14	Theory of simple bending, bending stresses, section modulus	Explain theory of simple bending, bending stresses, section modulus	Lecture/Flipped Classroom	4	Home Assignment Mid Term

					End Term
15	Transverse shear stress	Estimate transverse shear stress distribution in circular, hollow circular	Lecture	4	In class quiz Mid Term End Term
16	Transverse shear stress	Estimate transverse shear stress distribution in I, Box, T, angle sections	Lecture/Flipped Classroom	4	In class quiz Mid Term End Term
17	Transverse shear stress	Estimate transverse shear stress distribution in I, Box, T, angle sections	Lecture/Flipped Classroom	4	Home Assignment Mid Term End Term
18	Combined, Direct and Bending Stress	Estimate Combined, Direct and Bending Stress	Lecture	4	In class quiz Mid Term End Term
19	Combined, Direct and Bending Stress	Estimate Combined, Direct and Bending Stress	Lecture/Flipped Classroom	4	In class quiz Mid Term End Term
20	Torsional shear stress	Estimate Torsional shear stress in solid, hollow and stepped circular shafts	Lecture	1	In class quiz Mid Term End Term
21	Torsional shear stress	Estimate Angular deflection and power transmission capacity	Lecture/Flipped Classroom	1	In class quiz Mid Term End Term
22	Torsional shear stress	Estimate Strain energy in torsion	Lecture/Flipped Classroom	1	In class quiz Mid Term End Term
23	Torsional shear stress	Estimate Strain energy in torsion	Lecture/Flipped Classroom	1	Home Assignment Mid Term End Term
24	Principal Planes, Stresses and Strains	Describe Principal Planes, Stresses and Strains	Lecture	2	In class quiz Mid Term End Term
25	Principal Stresses and Strains	Estimate principal stresses and strains in members subjected to combined axial, bending and torsional loads	Lecture	2	In class quiz Mid Term End Term
26	Principal Stresses and Strains	Estimate principal stresses and strains in members subjected to combined axial, bending and torsional loads	Lecture/Flipped Classroom	2	In class quiz Mid Term End Term
27	Principal Stresses and Strains	Estimate principal stresses and strains in members subjected to combined axial, bending and torsional loads	Lecture/Flipped Classroom	2	In class quiz Mid Term End Term
28	Principal Stresses and Strains	Estimate Maximum normal and shear stresses	Lecture/Flipped Classroom	2	In class quiz Mid Term End Term

29	Principal Stresses and Strains	Estimate equivalent bending and equivalent twisting moments	Lecture/Flipped Classroom	2	Home Assignment Mid Term End Term
30	Principal Stresses and Strains	Graphically estimate Principal Stresses and Strains Mohr's circle of stress and strain	Lecture	2	In class quiz Mid Term End Term
31	Principal Stresses and Strains	Graphically estimate Principal Stresses and Strains Mohr's circle of stress and strain	Lecture/Flipped Classroom	2	Home Assignment Mid Term End Term
32	Introduction of column	Distinguish between column and strut.	Lecture	5	In class quiz Mid Term End Term
33	Instability and elastic stability, long and short columns, ideal strut	Analysis effect of different column on varying end condition.	Lecture	5	In class quiz Mid Term End Term
34	Instability and elastic stability, long and short columns, ideal strut	Analysis effect of different column on varying end condition.	Lecture/Flipped Classroom	5	In class quiz Mid Term End Term
35	Euler's formula for crippling load for columns of different ends	Establish Euler's formula for crippling load in different condition.	Lecture/Flipped Classroom	5	In class quiz Mid Term End Term
36	Concept of equivalent length, eccentric loading	Reveal importance of equivalent length over actual length.	Lecture	5	In class quiz Mid Term End Term
37	Rankine formulae and other empirical relations	Differentiate crippling load calculation of Rankine formula & other formula.	Lecture/Flipped Classroom	5	Home Assignment Mid Term End Term
38	Relation between deflection, bending moment, shear force and load	Analyse Relation between deflection, bending moment, shear force and load	Lecture	3	In class quiz Mid Term End Term
39	Relation between deflection, bending moment, shear force and load	Analyse Relation between deflection, bending moment, shear force and load	Lecture	3	In class quiz Mid Term End Term
40	Transverse deflection of beams and shaft under static loading	Estimate Transverse deflection of beams and shaft under static loading	Lecture	3	In class quiz Mid Term End Term
41	Transverse deflection of beams and shaft under static loading	Estimate Transverse deflection of beams and shaft under static loading	Lecture/Flipped Classroom	3	In class quiz Mid Term End Term
42	Transverse deflection of beams and shaft under static loading	Estimate Transverse deflection of beams and shaft under static loading	Lecture/Flipped Classroom	3	Home Assignment Mid Term End Term
LAB Experiments					

1	To determine the Impact strength of a V-notched Mild Steel Specimen using Izod Impact Testing Machine.	Analyse impact strength of a V-notched Mild Steel Specimen using Izod Impact Testing Machine.	Practical	I	Lab Assessment /Final Lab Exam
2	To determine the Impact strength of U-notched Mild Steel specimen using Charpy Impact Testing Machine.	Analyse impact strength of U-notched Mild Steel specimen using Charpy Impact Testing Machine.	Practical	I	Lab Assessment /Final Lab Exam
3	To obtain the Brinell hardness number (BHN) of a given specimen using Brinell Hardness Testing Machine.	Analyse hardness using Brinell Hardness Testing Machine.	Practical	I	Lab Assessment /Final Lab Exam
4	To obtain the hardness value of a given specimen by using Rockwell Hardness Testing Machine	Analyse hardness using Rockwell Hardness Testing Machine.	Practical	I	Lab Assessment /Final Lab Exam
5	Study of Vicker's Hardness Testing Machine to determine the hardness value.	Analyse hardness using Vicker's Hardness Testing Machine.	Practical	I	Lab Assessment /Final Lab Exam
6	To determine the modulus of rigidity of a solid circular rod by conducting Torsion Test.	Analyse modulus of rigidity of a solid circular rod by conducting Torsion Test.	Practical	I	Lab Assessment /Final Lab Exam
7	To study the behavior of mild steel specimen under the action of gradually increasing load and determine yield stress, ultimate tensile strength, modulus of elasticity and Poisson's ratio of it.	Analyse yield stress, ultimate tensile strength, modulus of elasticity and Poisson's ratio of it.	Practical	I	Lab Assessment /Final Lab Exam
8	To find the Compressive Strength of a wooden specimen parallel to the grains by conducting Compression Test on CTM.	Analyse the Compressive Strength of a wooden specimen parallel to the grains by conducting Compression Test on CTM.	Practical	I	Lab Assessment /Final Lab Exam
9	To determine the Single shear strength of a mild steel specimen by Shear Test on UTM.	Analyse single shear strength of a mild steel specimen by Shear Test on UTM.	Practical	I	Lab Assessment /Final Lab Exam
10	To determine the Bending stress and Young's Modulus of elasticity of a material of beam simply supported at ends and carrying a concentrated load at the centre.	Analyse the Bending stress and Young's Modulus of elasticity of a material of beam simply supported at ends and carrying a concentrated load at the centre.	Practical	I	Lab Assessment /Final Lab Exam
11	To study about the fatigue testing machine, endurance limit of a specimen and S-N curve.	Analyse the fatigue testing machine, endurance limit of a specimen and S-N curve.	Practical	I	Lab Assessment /Final Lab Exam
12	To determine the Double Shear strength of a Mild Steel specimen using Universal Testing Machine.	Analyse the double Shear strength of a Mild Steel specimen using Universal Testing Machine.	Practical	I	Lab Assessment /Final Lab Exam
13	Study of an Open Coiled Helical Spring Testing Machine to determine the stiffness of a spring by conducting Compression Test.	Analyse the stiffness of a spring by conducting Compression Test.	Practical	I	Lab Assessment /Final Lab Exam
14	To determine the Compressive strength a wooden specimen Perpendicular to the grains using Compression Testing Machine.	Analyse the Compressive strength a wooden specimen Perpendicular to the grains using Compression Testing Machine.	Practical	I	Lab Assessment /Final Lab Exam

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
AU 1305.1	Analyse and design structural members subjected to tension, compression, torsion, bending and combined stresses using the fundamental concept of stress, strain and elastic behaviour of materials.	3	3	3	2								1		1	
AU 1305.2	Estimate principal stresses & strains under different loading conditions.	3	3	3	2								1		1	
AU 1305.3	Compute SFD & BMD, slope & deflection for different type of beams under given constraints.	3	3	3	2								1		1	
AU 1305.4	Estimate bending stress and shear stress distribution in different cross sections.	3	3	3	2								1		1	
AU 1305.5	Determine failure of column and strut by analysing different end conditions.	3	3	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 Automobile Engineering
Course Hand-out

Theory of Automotive Engines| AU 1306 | 3 Credits | 3 0 2 3

Session: Aug 19 – Dec 19 | Faculty: Vinoth R | Class: III Semester

A. Introduction: This course is offered by Dept. of Automobile Engineering as core course, to the III semester B.Tech Automobile Engineering program. Offers in depth knowledge IC Engine theory by covering SI, CI Engine introduction, subsystems and combustion. The course also gives an introductory level knowledge on newer techniques that are developed or in development in the field of IC engines. This course also serves as a prerequisite to other courses in higher semesters.

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

[1761.1] Understand and Explain different types of engine and their working

[1761.2] Analyse fuel induction system requirements and explain how fuel induction systems works in engine

[1761.3] Explain the need for lubrication, ignition and cooling systems and their working

[1761.4] Explain combustion and differentiate between normal and abnormal combustion in engines

[1761.5] Identify the need and explain the working of forced induction systems like superchargers and turbochargers in engines.

[1761.6] Dismantle, inspect for wear tear and reassemble and engine as per industry defined standards and guidelines

C. Program Outcomes and Program Specific Outcomes

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

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

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

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

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

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

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

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

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

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

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

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

[PSO.1]. Autotronics and Electric Vehicle Technology: Apply knowledge of electrical and electronics engineering for providing automobile engineering solutions

[PSO.2]. Alignment to Super Qualification packs of ASDC: Demonstrate knowledge and performance criteria as defined by ASDC super qualification packs for R&D or Quality or Service Engineering

[PSO.3]. Application of Lean Six Sigma Methodology: Demonstrate through an internship project, the knowledge and understanding of lean six sigma methodology based on Define, Measure, analyse, improve/develop and control/validate phases (DMAIC/ DMADV).

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

E. Syllabus

Engine Construction and Working- Classifications, Constructional details, working principle, 4 stroke engine, otto cycle, diesel cycle, dual cycle, indicator diagram, actual fuel and air cycles, cylinder layout and configurations, engine balancing Fuel, Cooling and Lubrication Systems – Carburetor, petrol injection in SI engines, firing order, flammability limits, AF requirement at different engine loads, GDI concept, Diesel fuel injection – conventional and CRDi, fuel pumps- jerk and distributor type, Injector, types of nozzles, electronic fuel injection. Spray characteristics, split and multiple injection, cooling systems- need, types- air, forced

circulation, pressure cooling and evaporative cooling systems, Lubrication systems – need, Types Mist, wet and dry sump lubrication, lubricants – properties, Coolant – Properties, Recent Technologies, Octane rating and cetane rating. Two stroke Engines – Types, terminologies, theoretical scavenging process, scavenging efficiency, scavenging pumps, rotary valve engine. Air motion, combustion and combustion chambers – Air intake systems, air motions- squish, swirl and tumble, swirl ratio, fuel air mixing, Stages of combustion in SI and CI engine, Delay period, Knocking in SI and CI engine, factors affecting combustion & knocking, Combustion chambers for SI and CI engine Supercharging and Turbocharging – Necessity and limitation, types of supercharging and turbocharging, intercooler, matching of supercharger, engine modifications, variable geometry, variable nozzle turbocharger, e-turbocharger, Modern Vehicle Technologies – DTSi, DTS-Fi, DTS-Si, VVT, Camless engine, Jetronic concepts

Lab: Engine overhaul and testing: Automotive petrol and diesel engine- dismantling, assembly, inspection for wear and tear, Workshop tools: types, functions, usage, workshop safety practice, tool arrangement, Automotive stationary petrol and diesel engine – performance tests for power and efficiency, variables affecting engine performance, engine performance terminologies, Heat balance, methods to improve engine performance, Morse test, study on dynamometers, FIP calibration

F. Text Books

T1. IC Engines 4th Edition, Ganesan V, Tata McGraw Hill

T2. Internal Combustion Engines, 3rd Edition, Ramalingam KK, Scitech Publications

G. Reference Books

R1. IC Engine Fundamentals, John Heywood, McGrawHill

R2. IC Engines, Mathur, Sharma, Dhanpat Rai Publications

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	Engines – Introduction	Explain heat engine and its types	Lecture	1306.1	In Class Quiz (Not Accounted)
3	Engines – Classification	Classify types of engine based on given parameters	Lecture	1306.1	In Class Quiz End Term
4	Cycles – Otto, Diesel and Dual cycles	Recall thermodynamic cycle and relate how these cycles contribute in operation of engines	Guided Self-Study	1306.1	Home Assignment End Term
5	Engines – 4 Stroke SI, CI engine	Explain how 4S SI and CI engine works	Lecture	1306.1	In Class Quiz Mid Term I End Term
6,7,8	Carburettor – Introduction, Simple Carburetor construction and modifications	Understand and explain how carburettor works and analyse the engine's fuel needs based on requirements	Lecture, Think Pair Share	1306.2	Class Quiz Mid Term I End Term
9,10,11,12	Fuel Injection Systems in SI engine – Port, Manifold and Electronic Injection	Understand and explain how fuel injection system works in SI engines	Lecture, Jigsaw, Live demos	1306.2	Class Quiz Mid Term I End term
13,14,15	Ignition Systems – Battery Coil, Magneto and Electronic Ignition systems	Understand and explain how different types of ignition systems works in engine	Lecture	1306.3	Home Assignment Class Quiz Mid Term II End Term
16,17,18	Lubrication Systems – Petroil, Mehanical and Pressure feed systems	Understand and explain how lubricaton systems works in engine and explain their necessity	Lecture, Jigsaw	1306.3	Class Quiz Mid Term II End Term
19,20	Cooling Systems – Air, Water Cooling	Explain the necessity and working of different cooling systems	Lecture	1306.3	Class Quiz Mid Term II End Term
21,22	Fuel Injection – CI engines, Fuel Pump	Explain how fuel injection systems works in CI engine	Lecture, Live Demo	1306.2	Class Quiz End Term
23	Combustion – Introduction	Understand and Explain combustion in engines	Lecture	1306.4	Class Quiz Mid Term II End Term
24	Combustion – SI engine	Explain combustion in SI engines and differentiate normal vs abnormal combustion	Lecture	1306.4	Class Quiz Mid Term II End Term

25	Combustion – Factors affecting combustion in SI engine	Analyse how different operating parameters affects combustion in SI engine	Lecture, Activity	1306.4	Class Quiz Mid Term II End Term
26	Combustion – CI engine	Understand and explain combustion in CI engines	Lecture	1306.4	Class Quiz Mid Term II End Term
27	Combustion – Delay period and factors affecting delay period	Explain the significance of delay period and how delay period affects combustion	Lecture	1306.4	Class Quiz End Term
28	Air Motion – Squish, Swirl and Tumble	Describe different types of air motion and their significance in engine combustion	Lecture	1306.4	Class Quiz End Term
29	Two Stroke Engines – Introduction	Explain how two stroke engine works	Flipped Class	1306.1	Class Quiz End Term
30	Scavenging	Describe scavenging and its necessity	Flipped Class	1306.1	Class Quiz End Term
31	Superchargers	Explain how superchargers works and its types	Lecture	1306.5	Class Quiz End Term
32	Turbochargers	Explain how turbochargers works and differentiate between super and turbochargers	Flipped Class	1306.5	Class Quiz End term
33	Supercharging & Turboharging – Matching	Understand and explain how super/turbochargers are mapped with engines	Lecture	1306.5	Class Quiz
34-40	Modern Technologies – DTSi, VVT, Jetronic concepts	Analyze and explain how DTSi VVT systems work in automobiles	Jigsaw	1306.1	Class Quiz Mid Term II End Term
41	Wankel Rotary Engine	Explain how wankel engine works and why it failed	Flipped Classroom	NA	NA
42	Camless Engine	Explain how camless engines works	Flipped Classroom	NA	NA
LAB SESSIONS	Lab sessions based on Engine Assy and Dismanting, Performance testing	Experiment on engines to qualify for ASDC Super QP certification	Lab Sessions	1306.6	Experimental results 14 lab sessions End Term Practical

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
AU 1306.1	Understand and Explain different types of engine and their working	3											1		2	
AU 1306.2	Analyse fuel induction system requirements and explain how fuel induction systems works in engine	3											1		2	
AU 1306.3	Explain the need for lubrication, ignition and cooling systems and their working	3											1		2	
AU 1306.4	Explain combustion and differentiate between normal and abnormal combustion in engines	3											1		2	
AU 1306.5	Identify the need and explain the working of forced induction systems like superchargers and turbochargers in engines.	3											1		2	
AU 1306.6	Dismantle, inspect for wear tear and reassemble and engine as per industry defined standards and guidelines	3									3	3	3		3	

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Automobile Engineering
Course Hand-out

Kinematics and Dynamics of Automobiles | AU 1308 | 4 Credits | 3 0 1 4

Session: Jul 19 – Dec 19 | Faculty: Satish Namdev | Class: III Sem

A. Introduction: This course is offered by Dept. of Automobile Engineering for fourth semester students. This course offers a knowledge in different kind of mechanics and mechanisms for automotive. This course is a complete stuff of different types of mechanism and mechanics are using in various components of an automobiles, e.g. cam and follower, governor, gyroscope, balancing for reciprocating and rotary parts in IC engine, brake system. Students are expected to have background knowledge on basic mechanics like fundamental of forces etc.

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

1. Describe importance of fundamentals of mechanics and mechanism used in an automobile.
2. Analyze and design profiles for a cam used in automotive Engine.
3. Analyze and solve problems related to centrifugal governor, gear design and their applications in an automobile to **improve problem solving skill.**
4. Describe and evaluate different types of forces and factors affect balancing of rotating and reciprocating parts of an automotive engines.
5. Describe, analyse and compute the factors those are involved with gyroscopic effect while turning a two wheeler as well as four wheeler.

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

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[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]. Autotronics and Electric Vehicle Technology: Apply knowledge of electrical and electronics engineering for providing automobile engineering solutions

[PSO.2]. Alignment to Super Qualification packs of ASDC: Demonstrate knowledge and performance criteria as defined by ASDC super qualification packs for R&D or Quality or Service Engineering

[PSO.3]. Application of Lean Six Sigma Methodology: Demonstrate through an internship project, the knowledge and understanding of lean six sigma methodology based on Define, Measure, analyse, improve/develop and control/validate phases (DMAIC/ DMADV).

D. Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Open/Closed Book)	15
	Sessional Exam II (Open/Closed Book)	15
	In class Quizzes and Assignments, Activity feedbacks (Accumulated and Averaged)	10
	Practical internal	15
	Practical External	05
End Term Exam (Summative)	End Term Exam (Open/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:

Basic Concepts: Mechanism and machine, kinematic pair, link, chain and inversions, Degree of Freedom, four bar mechanism and its inversion in automobile and linkages used in earth moving equipment,

Velocity and Acceleration: Solution of simple mechanisms for velocity and acceleration analysis, velocity and acceleration of crank slider crank mechanism used in IC Engines,

Cams: Types of cams, Types of followers, Follower displacement programming, Motions of followers like SHM, Uniform velocity and cycloidal motion, Layout of Cam profile for an IC Engine,

Gears: Introduction, Classification of Gears, Application of gears in automobile, Gear Terminology, Law of gearing, Involute tooth profile, Path of contact, Arc of contact, Contact ratio, Interference in involute gear, Parallel and crossed helical gear,

Gear trains: Simple, compound, reverted and epicyclic gear train, classification of automotive transmission using gear train, gear train Solution by tabular column method only, Torque transmitted by epicyclic gear train, differential gear drive of an automobile,

Static and dynamic balancing: Balancing of revolving masses in single plane and different planes, Balancing of in-line IC Engine and V type Engine,

Governors: Classification, Characteristics of governors, Porter and Proell governor, Hartnell governor, Centrifugal governors and modern automotive governors Gyroscope: Gyroscopic couple of a spinning disc, Stability of four wheelers and two wheelers while negotiating a turn.

F. Text Book:

1. S.S. Rattan, *Theory of machines*, Tata Mc Graw Hill, 2005.

G. References:

1. J.S. Rao, *Theory of machines and mechanisms*, New Age International, 2004.

2. H. H. Mabie, *Mechanisms and dynamics of machines*, John Wiley and sons, 1987.

3. J.E. Shigley, *Theory of Machines and Mechanisms*, Mc Graw Hill International, 1985

H. Lecture Plan:

Lec No	**Topics**	**Session Objective**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing the Outcome**
1	Introduction and Course Hand-out briefing	To acquaint and clear teachers expectations and understand student expectations	Lecture	NA	NA
2,3	Mechanism and machine, kinematic pair, link, chain and inversions,	**Explain importance of mechanism in an automobile**	Flipped Classroom	1308.1	Class Quiz (Not Accounted)
4,5	Degree of Freedom, four bar mechanism and its inversion in automobile and linkages used in earth moving equipment,	**Identify types of mechanisms are using in an automobile**	Lecture, Activity	1308.1	Class Quiz
6,7	Types of cams, Types of followers, Follower displacement programming,	**Explain various types of cam and follower and importance of displacement diagram**	Lecture	1308.2	Home Assignment
8-12	Motions of followers like SHM, Uniform velocity and cycloidal motion, Layout of Cam profile for an IC Engine,	**Draw a cam profile for different types of follower motion**	Flipped Classroom	1308.2	In Class Quiz (Not Accounted)

13	Introduction of gears, Friction wheels, Classification of toothed wheels (gears), Advantage and disadvantage of gear drive	**Identify role of toothed gears in automobile engineering**	Lecture/Flipped Classroom	1308.3	In Class Quiz (Not Accounted)
14,15	Terminology used in gear, gear materials, Law of gearing, Derive the expression for path of contact, arc of contact, contact ratio,	**Explain the concept of gears and illustrate examples for automotive applications**	Lecture	1308.3	In Class Quiz
16-18	Involute teeth and cycloidal teeth, Interference in involute gears, Minimum no. of teeth to avoid interference on pinion, Numerical problems	**Explain different types of profile of toothed gear for automotive applications**	Lecture	1308.3	Home Assignment
19,20	Introduction of Gear train, Types of gear train, velocity and gear ratio for different types of gear train, Torque Transmission	**Identify gear trains for automotive applications with various input data**	Flipped Classroom	1308.3	Home Assignment Class Quiz
21-23	Epicyclic Gear train velocity ratio, Compound epicyclic gear train (Differential gear box), Numerical problems	**Application of epicyclic gear train for automobile application**	Lecture	1308.3	Class Quiz
24,25	Static Balancing and Dynamic balancing of rotating masses in various Planes & Numerical based on its	**Describe balancing of various types masses rotating in different plane for automobile application**	Flipped Classroom	1308.4	Class Quiz
26,27	Static and Dynamic balancing of rotating mass in Different Plane (numerical)	**Describe various parameters affect balancing of an automobile**	Lecture/Activity	1308.4	Class Quiz
28	Primary and Secondary unbalanced forces of reciprocating masses	**Describe balancing of various types masses reciprocating in different plane for automobile application**	Lecture	1308.4	Class Quiz
29-31	Partially balancing of unbalanced primary force, Variation of Tractive force, Swaying Couple, Hammer Blow	**Describe various parameters affect balancing of an automobile**	Lecture	1308.4	Class Quiz
32-33	Balancing of V Engine & Numerical Problem	**Balancing for multi cylinder engine in automobile applications**	Lecture	1308.4	Class Quiz (Not Accounted)
34	Introduction of governor, Types of governor,	**Identify the requirement of governor for automobiles**	Lecture/Flipped Classroom	1308.3	Class Quiz (Not Accounted)
35-37	Porter governor, Proell Governor working and derivation, numerical	**Analyse different types of governor for automotive use**	Lecture/ Activity	1308.3	Class Quiz
38-39	Hartnell's governor & numerical	**Analyse different types of governor for automotive use**	Lecture	1308.3	Home Assignment
40-41	Introduction of Gyroscope, definition of gyroscopic	**Identify the requirement of**	Lecture/Activity	1308.5	Home Assignment

	couple, Precessional angular motion	**gyroscope for automobiles**			
42-44	Condition for stability of a four wheeler, Condition for stability of two wheeler.	**Describe balancing of vehicle while negotiating a turn on plane and banked surface**	Lecture	1308.5	Home Assignment

Week	LAB Module
1	Overview about Mini project Guidelines, Evaluation criteria and project distribution to students.
2	Decide work responsibility for every member in each group, prepare project process chart for complete mini project in next 12 weeks.
3-11	Project fabrication and Discussion about progress, difficulties and remedies related to their project. Update Project report regularly. Evaluate project progress weekly.
12	Prepare Final Project Report (Hard bound) as per prescribed format. Also prepare PPT for Project Presentation
13	Submission of Project report with model.
14	Project Presentation

I. Course articulation matrix ;- (Mapping of COs and 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
AU 1308.1	Describe importance of fundamentals of mechanics and mechanism used in an automobile.	3												1		
AU 1308.2	Analyze and design profiles for a cam used in automotive Engine.				2			2								
AU 1308.3	Analyze and solve problems related to centrifugal governor, gear design and their applications in an automobile to **improve problem solving skill**		1							2					2	
AU 1308.4	Describe and evaluate different types of forces and factors affect balancing of rotating and reciprocating parts of an automotive engines						2		2	1				2		
AU 1308.5	Describe, analyse and compute the factors those are involved with gyroscopic effect while turning a two wheeler as well as four wheeler		2				2					3			1	

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Automobile Engineering
Course Hand-out

Automotive Transmission systems | AU 1512 | 4 Credits | 3 0 2 4

Session: Aug 19 – Dec 19 | Faculty: Dalip Singh | Class: V Sem

A. Introduction: This course is offered as a Program elective course to the students of III Year B Tech Automobile Engineering. To give an introductory familiarization on automotive transmission, it's working principles, primary components that play a role in transmission which offers the essential knowledge required for a graduate automobile engineer and to gear up those, who are interested in research, and higher studies, for advanced courses offered as electives as they progress to higher semesters.

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

[1512.1] Describe automotive transmission, their working, and various subsystems that are essential for an efficient transmission.

[1512.2] Understand decipher of various terms used by automobile manufacturers such as CVT, AMT and 4x4 etc. and will be able to describe and make critical decisions whenever required.

[1512.3] Understand the fundamental prerequisite that is required in automotive transmission for working in the automotive sector, and will be able to define, analyse and compute the factors that are involved with transmission.

[1512.4] Understand the design prerequisite which is required in automotive sector and will be able to design the component that are involved with transmission.

[1512.5] Understand about problem, diagnosis and prerequisite routine and general maintenance of automotive transmission system, which leads to employability skill.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

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

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

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

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

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

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[PO.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]. Autotronics and Electric Vehicle Technology: Apply knowledge of electrical and electronics engineering for providing automobile engineering solutions

[PSO.2]. Alignment to Super Qualification packs of ASDC: Demonstrate knowledge and performance criteria as defined by ASDC super qualification packs for R&D or Quality or Service Engineering

[PSO.3]. Application of Lean Six Sigma Methodology: Demonstrate through an internship project, the knowledge and understanding of lean six sigma methodology based on Define, Measure, analyse, improve/develop and control/validate phases (DMAIC/ DMADV).

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)	10
	Practical internal	15
	Practical External	05
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

Power Required for Propulsion: Resistances to Motion of the Automobile, Traction, tractive effort, Performance curves, acceleration, grade ability, drawbar pull, Numerical Problems,

Clutch: Types of clutches, construction and operation of all types, Numerical problems,

Gear box: Performance characteristics in different gears , Desirable ratios of 3speed and 4speed gear boxes, Constructional details of different types of gear boxes , numerical problems,

Fluid Coupling and Torque converters :Constructional details, performance characteristics, slip, principles of torque multiplication, 3 and 4 phase torque converters, typical hydrodynamic transmission,

Epicyclic Transmission: Principle of operation, types of planetary transmission, Calculation of gear ratio in different speeds,

Hydrostatic Drives: Principles of hydrostatic drives, different systems of hydrostatic drives, construction and operations,

Automatic and Electric Transmissions: Construction and operation.

F. Text Book:

1. W.H.Crouse, *Automotive transmissions and power trains*, McGraw Hill Co. 5th edn, 1976.

G. References:

1. K.Newton and W. Steeds *Motor Vehicle*, W. Butter Worths and Co., Publishers Ltd, 1977.
2. Kirpal Singh, *Automobile engineering Vol.1*, Standard Pub, 2004.
3. G.B.S.Narang, *Automobile Engineering*, Khanna publication, New Delhi, 2008.

H. Lecture Plan:

Lec No	Topics	**Session Objective**	**Mode of Delivery**	**Bloom's Level**	**Mode of Assessing the Outcome**
1.	Introductory Class-Course briefing and explaining the outcomes	To acquaint and clear teachers expectations and understand student expectations	Lecture	NA	NA
2.	Power Required for Propulsion	Discuss about Propulsion of vehicles	Flipped Classroom	1	Class Quiz (Not Accounted)
3.	Resistances to Motion of the Automobile	Explain Resistances to Motion of the Automobile	Lecture, Activity	2,3,4	Class Quiz
4.	Traction,	Importance of Traction,	Lecture	3	Home Assignment
5.	tractive effort,	Importance of tractive effort,	Activity (Think Pair Share)	3	Home Assignment
6.	Performance curves	Explain Performance curves	Lecture	4	Home Assignment
7.	acceleration,	Presentation by students acceleration,	Flipped Classroom	1	In Class Quiz (Not Accounted)
8.	grade ability,	Presentation by students grade ability,	Flipped Classroom	1	In Class Quiz (Not Accounted)
9.	drawbar pull	Explain drawbar pull	Lecture	**2**	In Class Quiz
10.	Clutch: Introduction	Explain Clutch: Introduction	Lecture, Activity	2	Class Quiz
11.	Types of clutches	Explain Types of clutches	Lecture	2	Class Quiz
12.	clutch construction	Brief clutch construction	Lecture	3	Class Quiz (Not Accounted)

13.	operation of all types,	Presentation by students operation of all types,	Flipped Classroom	1	Class Quiz (Not Accounted)
14.	Gear box:Introduction	Importance and working principle Gear box:Introduction	Activity (Think Pair Share)	3	Home Assignment
15.	Gear box:Need and Requirements	Explain Gear box:Need and Requirements	Lecture	4	Home Assignment
16.	Performance characteristics in different gears	Performance characteristics in different gears	Flipped Classroom	1	Class Quiz (Not Accounted)
17.	Tutorial Test/Quiz	Tutorial Test/Quiz	Lecture, Activity	2,3,4	Class Quiz
18.	Desirable ratios of 3speed and 4speed gear boxes	Desirable ratios of 3speed and 4speed gear boxes	Lecture	3	Home Assignment
19.	Constructional details of different types of gear boxes	Constructional details of different types of gear boxes	Activity (Think Pair Share)	3	Home Assignment
20.	Fluid Coupling and Torque converters	Presentation by students Fluid Coupling and Torque converters	Flipped Classroom	1	In Class Quiz (Not Accounted)
21.	Constructional details	Constructional details	Lecture	**2**	In Class Quiz
22.	performance characteristics, slip	performance characteristics, slip	Lecture	**1,2**	Home Assignment
23.	principles of torque multiplication,	principles of torque multiplication,	Lecture	2	Class Quiz
24.	3 and 4 phase torque converters,	Presentation by students 3 and 4 phase torque converters,	Flipped Classroom	2,3	Class Quiz
25.	typical hydrodynamic transmission	typical hydrodynamic transmission	Lecture, Activity	2	Class Quiz
26.	Epicyclic Transmission	Epicyclic Transmission	Lecture	2	Class Quiz
27.	Principle of operation	Principle of operation	Lecture	3	Class Quiz (Not Accounted)
28.	types of planetary transmission,	Presentation by students types of planetary transmission,	Flipped Classroom	1	Class Quiz (Not Accounted)
29.	Calculation of gear ratio in different speeds	Calculation of gear ratio in different speeds	Lecture, Activity	2,3,4	Class Quiz
30.	Hydrostatic Drives	Hydrostatic Drives	Activity (Think Pair Share)	3	Home Assignment
31.	Principles of hydrostatic drives	Principles of hydrostatic drives	Lecture	4	Home Assignment
32.	different systems of hydrostatic drives	Presentation by students different systems of hydrostatic drives	Flipped Classroom	1	Class Quiz (Not Accounted)
33.	hydrostatic drives, construction	hydrostatic drives, construction	Lecture, Activity	2,3,4	Class Quiz
34.	hydrostatic drives operations	hydrostatic drives operations	Lecture	3	Home Assignment
35.	Automatic Transmissions: Construction	Automatic Transmissions: Construction	Activity (Think Pair Share)	3	Home Assignment
36.	Automatic Transmissions: operation.	Automatic Transmissions: operation.	Lecture	4	Home Assignment
37.	Electric Transmissions: Construction	Presentation by students Electric Transmissions: Construction	Flipped Classroom	1	In Class Quiz (Not Accounted)
38.	Electric Transmissions: operation	Presentation by students Electric Transmissions: operation	Flipped Classroom	1	In Class Quiz (Not Accounted)

I. Course articulation matrix ;- (Mapping of COs and 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
AU 1512.1	Describe automotive transmission, their working, and various subsystems that are essential for an efficient transmission	2												1	2	
AU 1512.2	Understand decipher of various terms used by automobile manufacturers such as CVT, AMT and 4x4 etc. and will be able to describe and make critical decisions whenever required		3	2				2							2	
AU 1512.3	Understand the fundamental prerequisite that is required in automotive transmission for working in the automotive sector, and will be able to define, analyse and compute the factors that are involved with transmission		1							2					3	
AU 1512.4	Understand the design prerequisite which is required in automotive sector and will be able to design the component that are involved with transmission						2		2	1					2	
AU 1512.5	Understand about problem, diagnosis and prerequisite routine and general maintenance of automotive transmission system, which leads to employability skill		2				2					3			3	

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Automobile Engineering
Course Hand-out

Heat transfer in automotive system | AU 1513 | 4 Credits | 3 0 2 4

Session: Jul 19 – Dec 19 | Faculty: Rakesh Kumar | Class: III Year V Semester

A. Introduction: This course is offered as a core course to the students of III Year B Tech Automobile Engineering. This course offers in depth knowledge including various modes of heat transfer, heat transfer in various automotive component i.e Radiator, fan, hose, fins etc. Students are expected to have background knowledge on Engineering Mathematics, Kinematics, dynamics and Strength of Materials and be familiar with thermodynamics for better learning.

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

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[1513.1]. Describe types of heat transfer, interpret and analyse temperature, compute heat transfer coefficient in automotive components

[1513.2]. Compute heat transfer rate through plane, cylindrical, spherical and extended surfaces and interpret it to automobile.

[1513.3]. Describe various types of heat exchangers and its application in an automobile.

[1513.4]. Design and analyze the performance of heat exchangers to increase the innovative skills.

[1513.5]. Design and analyze heating and cooling systems

[1513.6]. Describe heat loss by radiation and its importance 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

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

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

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

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

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

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

[PSO.1]. **Autotronics and Electric Vehicle Technology:** Apply knowledge of electrical and electronics engineering for providing automobile engineering solutions

[PSO.2]. **Alignment to Super Qualification packs of ASDC:** Demonstrate knowledge and performance criteria as defined by ASDC super qualification packs for R&D or Quality or Service Engineering

[PSO.3]. **Application of Lean Six Sigma Methodology:** Demonstrate through an internship project, the knowledge and understanding of lean six sigma methodology based on Define, Measure, analyse, improve/develop and control/validate phases (DMAIC/ DMADV).

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 (Accumulated and Averaged)	10
	Practical performance (internal)	15
	Practical Assessment	5
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, combined modes, conductivity and film coefficient of heat transfer, Thermal diffusivity, overall heat transfer coefficient, thermal resistance and conductance. **Heat Transfer by conduction** :General heat conduction equation ,Linear heat flow through Plane Wall, Composite Walls, radial heat flow through cylinder, Composite Cylinders, Sphere and Composite spheres, critical thickness of insulation **Heat Transfer from Extended Surfaces:** Heat transfer from fins of uniform cross section heated at one end or both ends, Efficiency and effectiveness of fin, **Heat Transfer by convection:** Free and forced convection heat transfer, Application of dimensional analysis to free and forced convection, Reynolds, Prandtl, Grashof, Nusselt and Stanton numbers, **Heat Exchangers:** Classification of heat exchanger. Analysis using LMTD, Effectiveness-NTU Method, fouling mechanism, growth and design to minimize fouling, small types of heat exchangers, Plate-Fin heat exchangers **Heat transfer in IC engines:** Radiator construction, Engine Cooling system construction, coolant properties. Design parameters for radiator & water pump design, hoses, Thermostat Valve, Radiators Cap, Radiator fan,

Radiator Fan shroud, Surge Tank. **Radiation:** Thermal radiation, absorption, reflection and transmission of radiation, Kirchhoff's Law. Wien's displacement Law, Stefan Boltzmann's law, Intensity of radiation, Lambert's cosine law.
Lab: Thermal conductivity of concentric sphere ,Heat transfer through lagged pipe, Heat transfer in pin-fin, Heat transfer in forced convection apparatus, Heat transfer in natural convection, Parallel and counter flow heat exchanger, Emissivity apparatus, Stefan Boltzman Apparatus.

F. Text Book:

T1. . Dutta, Binay K, *Heat Transfer: Principles and Applications*, PHI Publication

G. References:

R1. S G Arora and S Domkundwar, *A course in Heat and Mass transfer*, Dhanpat Rai and Co, 2008.
R2. Mathur and Sharma, *Internal combustion engine* Dhanpat Rai Publications, P. Ltd, 2009.

H. Lecture Plan:

Lecture No.	Topics	Session Ooutcomes	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	**Introduction**	To acquaint and clear teachers expectations and understand student expectations	Lecture	NA	
2,3	Various modes of heat transfer, combined modes	Describe modes of heat transfer, its physical importance in automobile	Lecture	[1513.1]	Home Assignment Class Quiz Mid term End term
4,5	conductivity and film coefficient of heat transfer, Thermal diffusivity, overall heat transfer coefficient, thermal resistance and conductance	Describe all terms related to heat transfer and their significance	Lecture	[1513.1]	
6,7	**Heat Transfer by conduction** :General heat conduction equation	Describe General heat conduction equation	Lecture	[1513.1]	
7,8,9	Linear heat flow through Plane Wall, Composite Walls,	Compute heat transfer in plane wall and composite wall	Lecture	[1513.2]	
10,11,12	radial heat flow through cylinder, Composite Cylinders, Sphere and Composite spheres	Compute heat transfer in cylinders and spheres		[1513.2]	
13	critical thickness of insulation	Compute critical thickness of insulation to get maximum heat transfer	Lecture	[1513.2]	
14,15,16	**Heat Transfer from Extended Surfaces:** Heat transfer from fins of uniform cross section heated at one end or both ends,	Describe heat transfer from extended surface, Apply knowledge in automobiles	Lecture Flipped Classroom	[1513.2]	
17	Efficiency and effectiveness of fin	Apply knowledge of fins in automobiles	Lecture Flipped Classroom	[1513.2]	
18	**Heat Transfer by convection:** Free and forced convection heat transfer	Describe free and forced convection	Lecture	[1513.1]	Home Assignment Class Quiz Mid term
19,20	Application of dimensional analysis to free and forced	Describe dimensionless number ad their usage	Lecture		

	convection, Reynolds, Prandtl, Grashof, Nusselt and Stanton numbers		Flipped Classroom		End term
21	**Heat Exchangers:** Classification of heat exchanger	Describe HEs	Lecture	[1513.3]	Home Assignment Class Quiz Mid term End term
22,23	Analysis using LMTD,	Describe LMTD method	Lecture	[1513.4]	
24,25	Effectiveness-NTU Method.	Describe NTU method	Lecture	[1513.4]	
26	fouling mechanism, growth and design to minimize fouling,	Recall Fouling mechanism	Lecture	[1513.4]	
27,28,29	small types of heat exchangers, Plate-Fin heat exchangers	Apply knowledge of HEs in automobiles	Lecture Flipped Classroom	[1513.4]	
30,31,32	**Heat transfer in IC engines:** Radiator construction, Engine Cooling system construction, coolant properties.	Describe radiator used in automobiles	Lecture Flipped Classroom	[1513.5]	Home Assignment Class Quiz End term
33,34,35	Design parameters for radiator & water pump design, hoses, Thermostat Valve, Radiators Cap, Radiator fan, Radiator Fan shroud, Surge Tank.	Describe cooling system component in automobile	Lecture Flipped Classroom	[1513.5]	
36,37	**Radiation:** Thermal radiation, absorption, reflection and transmission of radiation	Recall radiation and terms used in it	Lecture	[1513.6]	Home Assignment Class Quiz Mid term End term
38,39,40	Kirchhoff's Law, Wien's displacement Law, Stefan Boltzmann's law,	Describe laws of radiations	Lecture	[1513.6]	
41,42	Intensity of radiation, Lambert's cosine law	Describe laws of radiations	Lecture	[1513.6]	

	Lab Module
1	Determination of thermal conductivity (K) of Composite walls
2	Determination of calorific values (CV) of gaseous fuels by Boys calorimeter
3	Determination of flash and fire points of oils (Open Cup & Closed cup)
4,	Determination of thermal conductivity (K) of insulating powder filled between two spheres
5	Determination of Stefan Boltzmann's Constant (σ) of a test plate through experiment
6	Determination of emissivity (ε) of a test plate in comparison with black plate
7	Determination of rate of heat transfer and thermal conductivity of lagged material kept in concentrated pipes
8	Determination of rate of heat transfer through natural convection
9	Determination of rate of heat transfer through forced convection
10	Calculation of effectiveness in parallel flow heat exchangers
11	Calculation of effectiveness in counter flow heat exchangers
12	Estimation of heat transfer coefficient (h) of a pin fin (circular) apparatus through forced convection
13	Determination of thermal conductivity (K) of Copper rod placed in a shell
14	Calibration of Thermocouple apparatus through suitable media and comparison of induced error

I. Course articulation matrix ;- (Mapping of COs and 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
AU 1513.1	Describe types of heat transfer, interpret and analyse temperature, compute heat transfer coefficient in an automotive components	3	2						1	1						
AU 1513.2	Compute heat transfer rate through plane, cylindrical, spherical and extended surfaces and interpret it to automobile.		2	1	2					2						
AU 1513.3	Describe various types of heat exchangers and its application in an automobile.	2	2													
AU 1513.4	Design and analyze the performance of heat exchangers.		2	3	2					2						
AU 1513.5	Design and analyze heating and cooling systems		2	3	2					2						
AU 1513.6	Describe heat loss by radiation and its importance in Automobile	2	2							2						

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Automobile Engineering
Course Hand-out

Automotive Design | AU 1514 | 4 Credits | 3 0 2 4

Session: July 19 – Nov 19 | Faculty: Ashu Yadav | Class: III Year V Semester

A. Introduction: This course is offered as a core course to the students of III Year B. Tech Automobile Engineering. This course offers in depth knowledge including design of flywheel, engine components, clutches, brakes, suspension spring and gears. Students are expected to have background knowledge on Engineering Mathematics, Kinematics, and Strength of Materials. This course helps automobile engineering students in design and fabrication of components in automobiles.

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

[1514.1]. Classify different aspects of design, analyze design procedures based on requirements.

[1514.2]. Design flywheel by analysing constraints like speed fluctuation, moment of inertia, stresses etc.

[1514.3]. Recall working of engine, analyze various engine operating requirements and design all its aggregate components.

[1514.4]. Design different types of clutches, brakes and suspension springs by interpreting different vehicle loads requirements to enhance employability.

[1514.5]. Explain gears and its importance in Automobile. Design and develop gears for automobile based on its requirements.

C. Program Outcomes and Program Specific Outcomes

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

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

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

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

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

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

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

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

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

[PO.10]. Communication: Communicate effectively on complex engineering activities with the engineering

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

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

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

[PSO.1]. Autotronics and Electric Vehicle Technology: Apply knowledge of electrical and electronics engineering for providing automobile engineering solutions

[PSO.2]. Alignment to Super Qualification packs of ASDC: Demonstrate knowledge and performance criteria as defined by ASDC super qualification packs for R&D or Quality or Service Engineering

[PSO.3]. Application of Lean Six Sigma Methodology: Demonstrate through an internship project, the knowledge and understanding of lean six sigma methodology based on Define, Measure, analyse, improve/develop and control/validate phases (DMAIC/ DMADV).

D. Assessment Rubrics:

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)	10
	Practical Internal	15
End Term Exam (Summative)	End Term Exam	40
	Practical External	05
	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: Auto Design, Various Aspects, Classification, Requirements, general procedure of design, principles of design optimization, Brain storming. **Design of flywheel:** Determination of the mass of a flywheel for a given co-efficient of speed fluctuation. MI of flywheel, Engine flywheel - stresses on the rim of the flywheels. Design of hubs and arms of the flywheel, turning moment diagram. **Design of Engine Components:** Design of various cylinder heads and cover plates Design of piston, piston pin, piston rings and their materials, design of connecting rod and its material. Design of crank shaft, crankshaft materials, Design considerations of valve design, intake and exhaust valve design, Design of rocker arm. **Design of clutches and Brakes:** Design of Single plate clutch, Multi plate clutch, and Centrifugal Clutch. Design of Drum brake and Disc brake. **Design of Suspension Spring:** Design of laminated leaf

spring and coil spring. **Design of Gear:** Design consideration- Strength of gear teeth, Lewis equation- Dynamic tooth load. Design of Spur Gear and helical gears.

LAB: - Design of various engine components, Design of flywheel, clutches, brakes, Suspension springs and Gears using design software.

F. TEXT BOOKS

T1. J. Shigley, Mechanical Engineering Design, McGraw Hill, SI-FPS Edition, 1980.

T2. M.F. Spotts, Design of Machine Elements, Prentice Hall, India, New FPS-SI Edition, 1980.

G. REFERENCE BOOKS

R1. V. B. Bhandari, Design of Machine Elements, Tata McGraw Hill Publishing Company, New Delhi, 1904.

R2. R. B. Gupta, Auto Design, Satya Prakashan, New Delhi, 2015.

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	Auto Design, Various Aspects, Classification, Requirements, general procedure of design	Classify various design types, identify design requirements for a given component	Lecture	1	Home Assignment Mid term End Term
3	Principles of design optimization, Brain storming	Describe design and optimize design procedure, Brain storm different design ideas and identify suitable design	Lecture	1	Home Assignment
4	Flywheel design	Determination of the mass of a flywheel for a given co- efficient of speed fluctuation. MI of flywheel	Lecture	1,2	In class quiz Mid term End Term
5	Flywheel design	Determine stresses on the rim of engine flywheels	Lecture/ Flipped Classroom	1,2	In class quiz Mid term End Term
6	Flywheel design	Design a flywheel by interpreting given constraints and performance requirements	Lecture/ Flipped Classroom	1,2	Home Assignment Mid term End Term
7,8	Flywheel design	Design hubs and arms of the flywheel, turning moment diagram.	Lecture/ Flipped Classroom	1,2	In class quiz Mid term End Term
9,10	Engine component design	Analyze performance requirements and calculate design requirements for various cylinder heads and cover plates	Lecture/ Flipped Classroom	1,3	In class quiz Mid term End Term
11,12	Engine component design	Analyze performance requirements and calculate design requirements for piston, piston pin, piston rings and select their materials accordingly	Lecture/Flipped classroom	1,3	In class quiz Mid term End Term
13,14	Engine component design	Analyze performance requirement and calculate design requirements for connecting rod and select material accordingly	Flipped classroom	1,3	In class quiz Mid term End Term
15,16	Engine component design	Calculate design requirements for crank shaft and select crankshaft materials	Flipped classroom	1,3	In class quiz Mid term End Term
17,18	Engine component design	Calculate design requirements for intake, exhaust valves and rocker arm	Lecture/Flipped classroom	1,3	In class Quiz Mid term End Term
19,20	Engine component design	Design crankshaft, valves and rocker arms based on given design requirements	Lecture/Flipped classroom	1,3	In class quiz Mid Term End Term

21,22	Clutch design	Recall clutch properties, requirements and calculate design requirements for a single plate and multiplate clutch for an automobile	Lecture/Flipped classroom	1,4	In class quiz Mid Term End Term
23	Clutch design	Recall clutch properties, requirements and calculate design requirements for centrifugal clutch for an automobile	Lecture/Flipped classroom	1,4	In class quiz Mid Term End Term
24,25	Clutch design	Select an appropriate clutch based on given requirements and design the clutch based on performance requirements	Lecture/Flipped classroom	1,4	Home Assignment Mid Term End Term
26,27	Brakes design	Recall brakes, brake efficiency and calculate design requirements for a drum brake	Lecture	1,4	In class quiz Mid Term End Term
28,29	Brake design	Recall brakes, brake efficiency and calculate design requirements for a disc brake for an automobile	Lecture/Flipped classroom	1,4	In class quiz Mid Term End Term
30,31	Brake design	Select an appropriate brake based on given requirements and design a brake for given performance requirements	Lecture/Flipped classroom	1,4	Home Assignment Mid Term End Term
32	Suspension design	Calculate design requirements of laminated leaf spring based on performance requirements	Lecture	1,4	In class quiz Mid Term End Term
33,34	Suspension design	Calculate design requirements of coil spring based on performance requirements	Lecture/Flipped classroom	1,4	In class quiz Mid Term End Term
35,36	Suspension design	Analyze performance requirements and select an appropriate suspension, design suspension based on requirements	Lecture/Flipped classroom	1,4	Home Assignment Mid Term End Term
37	Gear design	Analyze Design consideration and determine Strength of gear teeth, dynamic tooth load.	Lecture/Flipped classroom	1,5	In class quiz End Term
38	Gear design	Calculate design requirements for a spur gear	Lecture/Flipped classroom	1,5	In class quiz End Term
39	Gear design	Calculate design requirements for a Helical gear	Lecture/Flipped classroom	1,5	In class quiz End Term
40,41,42	Gear design	Analyze performance requirements, select appropriate gear and design the gear based on requirements	Lecture/Flipped classroom	1,5	Home Assignment Mid Term End Term

Lab	Lab Module
1	Introduction of CATIA V6.
2	Introduction to sketcher module

3	Overview of sketcher module commands.
4	Practice exercise using sketcher commands
5	Introduction of Part module
6	Overview of part module commands.
7	Overview of part module commands.
8	Practice exercise using part module commands
9	Practice exercise using part module commands
10	Practice exercise using part module commands
11	Introduction to assembly module
12	Practice exercise using assembly module commands
13	Practice exercise using assembly module commands
14	Mini project using above modules

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
AU 1514.1	Classify different aspects of design, analyze design procedures based on requirements.	3	3	3									1			
AU 1514.2	Design flywheel by analysing constraints like speed fluctuation, moment of inertia, stresses etc.	3	3	3									1			
AU 1514.3	Recall working of engine and, analyze various engine operating requirements and design its aggregate components.	3	3	3									1			
AU 1514.4	Design different types of clutches, brakes and suspension springs by interpreting different requirements and vehicle loads requirements.	3	3	3									1			
AU 1514.5	Explain gears and its importance in Automobile. Design and develop gears for automobile based on its requirements.	3	3	3									1			

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

MANIPAL UNIVERSITY JAIPUR
School of Automobile, Mechanical & Mechatronics Engineering
Department of Automobile Engineering
Course Handout
[Organization and Management | BB1540 | 3 Credits |
Session: July – December 2019 | Faculty: Arun Gautam | Class: B Tech V Semester|

A. Course Introduction: Today's world consists of many local, national, multinational and global organizations. Success of all business depends on their effective and efficient management. Therefore, management plays a most powerful and crucial role in the success and survival of the whole world. The significance of the course enlightens the dynamic life-giving element in every business. Consequently, it will emerge as a great resource as well an important 'discipline of learning' in the modern business world. The objective is to provide an understanding of basic concepts, principles and practices of organization and management. The aim is to inculcate the ability to apply multifunctional approach to organizational objectives. This course will enable students understand the basic concept of organization and management and various functions of it.

B. Course Outcomes: On completion of the course the students shall be able to:

[BB1540.1]. Understand theory and practice of organization and management.
[BB1540.2]. Build a comprehensive knowledge about marketing and personnel management
[BB1540.3]. Develop the skills of leadership and motivation.
[BB1540.4]. Illustrate the concept of entrepreneurship.
[BB1540.5]. Develop the knowledge of management information system (MIS).

C. Program Outcomes and Program Specific Outcomes

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

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

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

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

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

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

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

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

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

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

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

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

D. Assessment Plan

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	15
	Sessional Exam II (Closed Book)	15
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

Make up Assignments (Formative)	Students who misses 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

Unit 1: 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.

Unit 2: Introduction, Functions of Personal Management, Development of Personal Policy, Manpower Planning, Recruitment and Selection of manpower.

Unit 3: Motivation – Introduction, Human needs, Maslow's Hierarchy of needs, Types of Motivation, Techniques of Motivation, Motivation Theories, McGregor's Theory, and Herzberg's Hygiene Maintenance Theory. Leadership - Introduction Qualities of a good Leader, Leadership Styles, Leadership Approach, Leadership Theories.

Unit 4: Entrepreneurship – Introduction, Entrepreneurship Development, Entrepreneurial Characteristics, Need for Promotion of Entrepreneurship, Steps for establishing small scale unit.

Unit 5: 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
T3. E. S. Buffa and R. K. Sarin "Modern Production / Operations Management", 8th Edition, Wiley, 1987

G. Reference Books

R1. H. J. Arnold and D. C. Feldman "Organizational Behavior", McGraw – Hill
R2. Aswathappa K: Human Resource and Personnnel Management, Tata McGraw Hill
R3. William Wether& Keith Davis, Human Resource and Personnel Management, McGraw Hill

H. Lecture Plan

Lecture No.	PARTICULARS	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1.	Meaning and definition of an organization, Necessity of Organization	Understands the importance and concepts of organization management.	Lecture PPT , Discussion	BB1540.1	Class Quiz Mid Term I End Term
2.	Principles of Organization, Formal and Informal Organizations	Learn and understand the process and principles as well learn types of organizations	Lecture PPT, Discussion	BB1540.1	Class Quiz Mid Term I End Term
3.	Management Function: Planning & Organizing	Learn the principles of management and administration as well how they are applicable in a business Organization	Lecture PPT, Discussion	BB1540.1	Class Quiz Mid Term I End Term
4.	Management Function: Leading & Controlling	Understand the basic process of various management functions and how they are applicable in the organization	Lecture PPT, Discussion	BB1540.1	Class Quiz Mid Term I End Term
5.	Managerial Skills, Importance of Management,	Understanding of different managerial skills	Lecture PPT, Discussion	BB1540.1	Class Quiz Mid Term I End Term
6.	Activity	Understanding of previous lectures	Class activity	BB1540.1	Quiz/ Case study
7.	Models of Management: Scientific and Administrative management	Students will gain the knowledge of different Scientific and Administrative management	Lecture , Discussion	BB1540.1	Class Quiz Mid Term I End Term
8.	Models of Management: Behavioral approach	Understand the approach of behavioral management	Lecture , Discussion	BB1540.1	Class Quiz Mid Term I End Term

9.	Activity related models of management	Understanding of previous lectures	Class activity	BB1540.1	Class Quiz/ case study
10.	Forms of Ownership and Organization Structures	Understanding of Ownership and Organization Structures	Lecture, Discussion	BB1540.2	Class Quiz Mid Term I End Term
11.	Activity	Understanding of previous lectures	Class activity	BB1540.2	Class Quiz/ case study
12.	Purchasing Function and Marketing Function	Understanding of purchasing function and marketing function	Lecture PPT ,Discussio n	BB1540.2	Class Quiz Mid Term I End Term
13.	Advertising and Changing Dynamics of Advertising	Students will gain knowledge of advertising and how advertising is changing with market	Lecture PPT, Discussion	BB1540.2	Class Quiz Mid Term I End Term
14.	Activity	Understanding of previous lectures	Class activity	BB1540.2	Class Quiz/ case study
15.	Introduction, Functions of Personnel Management, Development of Personnel Policy	Understanding of human resource function and policies of personnel management	Lecture PPT, Discussion	BB1540.2	Class Quiz Mid Term II End Term
16.	Manpower Planning	Students will gain the knowledge of manpower planning	Lecture, Discussion	BB1540.2	Class Quiz Mid Term II End Term
17.	Recruitment of Manpower	Students will gain the knowledge of various steps and process of recruitment in human resource	Lecture PPT, Discussion :	BB1540.2	Class Quiz Mid Term II End Term

18.	Selection of Manpower	Students will gain the knowledge of various steps and process of selection in human resource	Lecture PPT, Discussion	BB1540.2	Mid Term II End Term
19.	Activity	Understanding of previous lectures	Class activity	BB1540.2	Class Quiz/ case study
20.	Introduction to Motivation, Human needs, Maslow's Hierarchy of needs	Understand the meaning of the motivation, human needs and the Maslow's theory of motivation Students will learn various types of motivation.	Recap of previous lecture, Lecture PPT, Discussion	BB1540.3	Class Quiz Mid Term II End Term
21.	Types and techniques of Motivation	Understand different techniques of motivation and their uses.	Lecture PPT, Discussion	BB1540.3	Class Quiz Mid Term II End Term
22.	McGregor's Theory, Herzberg's Hygiene Maintenance Theory	Students will learn the popular theories of motivation.	Lecture PPT, Discussion	BB1540.3	Class Quiz Mid Term II End Term
23.	Activity	Understanding of previous lectures	Class activity	BB1540.3	Class Quiz/ case study
24.	Leadership - Introduction Qualities of a good Leader, Leadership Styles	Students will learn different approaches of leadership.	Lecture PPT, Discussion	BB1540.3	Class Quiz Mid Term II End Term
25.	Leadership Theories	Understand different theories of leadership	Lecture PPT, Discussion	BB1540.3	Class Quiz Mid Term II End Term
26.	Leadership Theories	Understand different theories of leadership	Class Activity, PPT	BB1540.3	Class Quiz Mid Term II End Term

27.	Activity	Understanding of previous lectures	Class activity	BB1540.3	Class Quiz/ case study
28.	Entrepreneurship – Introduction, Entrepreneurship Development	Students will learn about entrepreneurship and its development.	Lecture PPT, Discussion	BB1540.4	Class Quiz Mid Term II End Term
29.	Entrepreneurial Characteristics, Need for Promotion of Entrepreneurship	Understand the characteristics and need for promoting entrepreneurship unit.	Lecture, Discussion	BB1540.4	Class Quiz Mid Term II End Term
30.	Steps for establishing small scale unit	Analyze the various steps involved in establishing small scale.	Lecture PPT, Discussion	BB1540.4	Class Quiz Mid Term II End Term
31.	Activity	Understanding of previous lectures.	Class activity	BB1540.4	Class Quiz/ case study
32.	Data and Information; Need and Importance of MIS	Understand the difference between data and information and the importance of managerial information system in an organization.	Lecture, Discussion	BB1540.5	Class Quiz End Term
33.	Functions of MIS and Evolution of MIS	Understand different phases related to evolution of MIS.	Lecture PPT, Discussion	BB1540.5	Class Quiz End Term
34.	Activity	Understanding of previous lectures	Class activity	BB1540.5	Class Quiz/ case study
35.	Organizational Structure and MIS	Understand the use of managerial information system in organizational structure. Student will learn about management information system.	Lecture PPT, Discussion	BB1540.5	Class Quiz End Term

36.	Activity	Analyze the close ended case study related to the management.	Case study	BB1540.5	Case study analysis
37.	Computers and MIS	Understand the basic requirement of management and computers in business	Lecture PPT, Discussion	BB1540.5	Class Quiz End Term
38.	Classification of Information Systems and Information Support for functional areas of management	Learn the importance of Control and it is the fourth and final principle element of the managerial process.	Lecture PPT, Discussion	BB1540.5	Class Quiz End Term
39.	Classification of Information Systems and Information Support for functional areas of management	Lear the controlling that intends to ensure that everything occurs in conformity with the plans	Lecture PPT, Discussion	BB1540.5	Class Quiz End Term

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

CO	STATEMENT			CORRELATION WITH PROGRAM OUTCOMES									
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 8	PSO 9	PSO 10	PSO 11	PSO 12
BB 1540.1	Understand theory and practice of organization and management									1		3	
BB 1540.2	Build a comprehensive knowledge about marketing and personnel management									2		2	
BB 1540.3	Develop the skills of leadership and motivation.									2		2	
BB 1540.4	Illustrate the concept of entrepreneurship.									2			
BB 1540.5	Develop the knowledge of management information system.									2	2		

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Automobile Engineering
Course Hand-out

Advanced Internal Combustion Engines| AU 1553 | 3 Credits | 3 0 2 3

Session: Aug 19 – Dec 19 | Faculty: Vinoth R | Class: Program Elective (V Sem)

A. Introduction: This course is offered by Dept. of Automobile Engineering as a program elective, targeting students who wish to pursue research& development in industries or higher studies in field of Automotive Engineering, including IC Engines, Fuels, and Emission reduction systems. Offers in depth knowledge IC Engine theory by covering SI, CI Engine combustion, genesis of pollutant formation, control techniques and gives an introductory level knowledge on emission standards, measurement devices and alternative fuels. Students are expected to have background knowledge on IC engines for a better learning.

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

[1553.1] Describe the effects of pollution on environment and depict engine and gas turbine pollution, its effect on global warming.

[1553.2] Interpret and illustrate the formation of different pollutants based on different operating and design parameters

[1553.3] Experiment different fuels on engine, analyse formation of pollutants, calculate engine performance and modify different operating parameters to control those emissions.

[1553.4] Recognize different emission control techniques and judge the best way to achieve overall emission control for a specific engine

[1553.5] Recall different commercial testing procedures for different types of vehicles, chose and test emissions in an automobile for Indian driving cycle.

[1553.6] Analyze and explain engine combustion and the factors that affects combustion in engines

C. Program Outcomes and Program Specific Outcomes

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

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

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

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

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

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

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

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

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

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

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

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

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

[PSO.1]. Autotronics and Electric Vehicle Technology: Apply knowledge of electrical and electronics engineering for providing automobile engineering solutions

[PSO.2]. Alignment to Super Qualification packs of ASDC: Demonstrate knowledge and performance criteria as defined by ASDC super qualification packs for R&D or Quality or Service Engineering

[PSO.3]. Application of Lean Six Sigma Methodology: Demonstrate through an internship project, the knowledge and understanding of lean six sigma methodology based on Define, Measure, analyse, improve/develop and control/validate phases (DMAIC/ DMADV).

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)	10
	Laboratory Sessions	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.	
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

Theory of SI and CI engine combustion, Ignition delay – physical and chemical, Flame velocity, area of flame front, fuel spray characteristics – droplet size, depth of penetration and atomization. Chemical energy, heat of reaction, chemical equilibrium and adiabatic flame temperature calculations, Combustion equation, progressive combustion, pre-mixed and diffusion combustion, flame quenching, flammability limits, Pollutant – sources, formation, effect of pollution on environment, human health, regulated and unregulated emissions, emission standards, Formation of NOx, CO, uBHC, smoke from petrol and diesel engines, Formation of soot, particulate, intermediate compounds from CI engine, Control of Pollutants – Catalytic converter, charcoal canister, PCV, secondary air injection, thermal reactor, Laser Assisted combustion, Fumigation, EGR, HCCI, Particulate traps, SCR, Testing and Emission measurements – Constant volume sampling 1 and 3, Sampling procedures, Chassis dyno, seven mode and thirteen mode cycle for emission sampling, emission analyzers – NDIR, FID, Chemiluminescent, smoke meters, dilution tunnels, SHED tests, Sensors for engine management- load, speed, air flow, temperature, pressure, lambda, throttle position, knock etc., their working principle and location, Non-conventional IC engines – concept of LHR, VCR, Wankel engine, dual fuel engine, free piston engine, stratified, lean burn, locomotive and marine engines. Photographic studies of combustion process – Analysis of P-Theta diagram, knock study for pressure crank angle histories, HWA, PIV, LDA, endoscope, optical engine for flow and combustion visualization, Alternative fuels like alcohols, vegetable oils, hydrogen, bio gas, natural gas – their production, properties, performance and emission standards, safety, material compatibility, engine modifications.

F. Text Books

T1. IC Engines Combustion and Emission, BP Pundir, Narosa Publications

T2. Handbook of Airpollution from combustion engines, Eran Sher, McGrawHill

G. Reference Books

R1. IC Engine Fundamentals, John Heywood, McGrawHill

R2. Pollution Manuals from ARAI, Federal Testing Procedures

R3. Alternative Fuels, SS Thipse, Jaico Publications

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	Engine Combustion – Introduction	Recall working of Engines, Engine combustion	Flipped Classroom	1553.6	In Class Quiz (Not Accounted)
3,4	Pollution – Introduction, Engine Pollutants	Identify different engine pollutants and describe their formation	Lecture	1553.1	In Class Quiz End Term
5,6	Global Warming, Green House Effect, Effects	Explain global warming and report the effects of global warming and its effects	Guided Self-Study	1553.1	Home Assignment End Term
7.8	Genesis of Pollutant Formation – Nox SI Engines	Recall Engine pollutants and interpret the formation of NOx from SI engine based on design, operating parameters	Lecture	1553.2	In Class Quiz End Term
9	Genesis of Pollutant Formation – Nox CI Engines	Recall Engine pollutants and interpret the formation of NOx from CI engine based on design, operating parameters	Activity (Think Pair Share)	1553.2	Class Quiz Mid Term I End Term
10	Genesis of Pollutant Formation CO SI and CI Engines	Recall Engine pollutants and interpret the formation of CO from SI&CI engine based on design, operating parameters. Compare formation of CO between SI and CI Engines	Activity (Jigsaw)	1553.2	Class Quiz Mid Term I End term
11	Genesis of Pollutant Formation – HC Emissions SI	Recall Engine pollutants and interpret the formation of HC from SI engine based on design, operating parameters	Flipped Class	1553.2	Home Assignment Class Quiz Mid Term I End Term
12	Genesis of Pollutant Formation – HC Emissions CI	Recall Engine pollutants and interpret the formation of HC from CI engine based on design, operating parameters	Activity (Think Pair Share)	1553.2	Class Quiz Mid Term I End Term
13	Genesis of Pollutant Formation – PM, Soot CI Engines	Recall Engine pollutants and interpret the formation of PM from	Lecture	1553.2	Class Quiz Mid Term I

		CI engine based on design, operating parameters. Interpret why PM emissions in SI Engine are negligible			End Term
14	Genesis of Pollutant Formation – Miscellaneous	Recall Engine pollutants and interpret the formation of Miscellaneous Polutants like sulphur, Aldehydes etc	Lecture	1553.2	Class Quiz End Term
15,16	Emission Reduction – Engine Design	Analyse engine design parameters for emission reduction and formulate various design changes that reduce engine pollutants	Jigsaw	1553.4	Class Quiz Mid Term II End Term
17	Emission Reduction – fuel changes, evaporative emissions control	Examine fuel properties and propose changes for emission reduction Locate different regions where evaporative emission occurs and propose design changes to minimize evaporative emissions	Lecture, Activity	1553.4	Class Quiz Mid Term II End Term
18	Emission Reduction- EGR, Air Injection Systems	Describe working of EGR , Air injection systems and synthesise the effects of EGR on emissions	Lecture, Activity	1553.4	Class Quiz Mid Term II End Term
19	Emission Reduction – Catalytic Converters, Water Injections	Describe working of Catalytic Converters, water injection systems and analyse the effects of catalytic converters on engine emissions and calculate converter efficiency	Lecture	1553.4	Class Quiz Mid Term II End Term
20	Emission Reduction – Sensors and Electronics	Describe the working of sensors and electronics in emission reduction	Lecture	1553.4	Class Quiz End Term
21	Emission Reduction – CRDI, Particulate Traps	Describe the working of CRDI, PTs in emission reduction	Flipped Class	1553.4	Class Quiz End Term
22	Emission Reduction – DeNOx, SCR systems	Describe the working of DeNOx and SCR in emission reduction	Flipped Class	1553.4	Class Quiz End Term
23	Emission Reduction – GDI, HCCI Concepts	Describe the working of GDI and HCCI in emission reduction	Flipped Class	1553.4	Class Quiz End Term
24	Emission Measurement – NDIR, Gas Chromotography	Describe the working of sensors and electronics in emission reduction	Flipped Class	1553.5	Class Quiz End Term
25	Emission Measurement – FID, Smoke Meters	Describe the working of FID and smoke meters in emission reduction	Flipped Class	1553.5	Class Quiz End term
26	Emission Measurement – PM and Noise Measurement	Describe the measurement of PM and NOx in engines	Flipped Class	1553.5	Class Quiz

27	Fuel Changes – Alternative Fuels Introduction	Identify different alternative fuels and analyse the ability of a specimen to be a fuel based on its properties	Lecture	1553.5	Class Quiz Mid Term II End Term
28,29	Alternative Fuels – Ethanol	Examine fuel properties, sketch and compare emission trends in engines	Flipped Classroom	1553.5 1553.3	Class Quiz Mid Term II End Term
30,31	Alternative Fuels – Hydrogen	Examine fuel properties, sketch and compare emission trends in engines	Flipped Classroom	1553.5 1553.3	Class Quiz Mid Term II End Term
32,33	Alternative Fuels – CNG, LPG	Examine fuel properties, sketch and compare emission trends in engines	Flipped Classroom	1553.5 1553.3	Class Quiz End Term
34,35	Alternative Fuels – Bio diesels	Examine fuel properties, sketch and compare emission trends in engines	Flipped Classroom	1553.5 1553.3	Class Quiz End Term
36, 37	Driving Cycles – Transient Dynamometers	Describe driving cycle procedures for different vehicles	Lecture	1553.1	Class Quiz End Term
38	US Driving Cycles	Describe driving cycle procedures for different vehicles	Flipped Classroom	1553.1	Class Quiz End Term
39	Euro Driving Cycles	Describe driving cycle procedures for different vehicles	Flipped Classroom	1553.1	Class Quiz End Term
40	Indian Driving Cycles	Describe driving cycle procedures for different vehicles	Flipped Classroom	1553.1	Class Quiz End Term
41	Conclusion and Course Summarization	NA	NA		NA
PROJECT	Project on preparation of biodiesel and testing biodiesel in engines	Experiment and test different fuels on engines and analyse their impact on pollution reduction	Lab Sessions	1553.3 1553.6	Project Report End Term Viva

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
AU 1553.1	Describe the effects of pollution on environment engine operation, gas turbine pollution, global warming.	3							1							
AU 1553.2	Interpret and illustrate the formation of different pollutants based on different operating and design parameters		2	2								2				
AU 1553.3	Experiment different fuels on engine, analyse formation of pollutants, calculate engine performance and modify different operating parameters to control those emissions.				2	2										
AU 1553.4	Recognize different emission control techniques and judge the best way to achieve overall emission control for a specific engine						2		2	3						
AU 1553.5	Recall different commercial testing procedures for different types of vehicles, chose and test emissions in an automobile for Indian driving cycle			1						1	1					
AU 1553.6	Analyze and explain engine combustion and the factors that affects combustion in engines	3											1			

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Automobile Engineering
Course Hand-out

Two & Three wheeled vehicles | AU 1554 | 3 Credits | 3 0 0 3

Session: July 19 – Nov 19 | Faculty: Dharmesh Yadav | Class: III Year V Semester

A. Introduction: This course is offered as a Program elective course to the students of III Year B Tech Automobile Engineering. This course offers in depth knowledge two and three wheeled vehicles and their components i.e brake, clutch, suspension, electrical, steering system etc. Students are expected to have background knowledge on basis working of all components for better learning.

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

[1554.1] Classify two wheeler and three wheeler for their significant use.
[1554.2] Explain various types of component used in two or three wheeled vehicle.
[1554.3] Learn assembling and dismantling of two and three wheeled vehicle.
[1554.4] Diagnose and service the 2 & 3 Wheeler for attaining employability skills.

C. Program Outcomes and Program Specific Outcomes

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

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

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

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

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

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

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

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

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

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

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

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

[PSO.1]. Autotronics and Electric Vehicle Technology: Apply knowledge of electrical and electronics engineering for providing automobile engineering solutions

[PSO.2]. Alignment to Super Qualification packs of ASDC: Demonstrate knowledge and performance criteria as defined by ASDC super qualification packs for R&D or Quality or Service Engineering

[PSO.3]. Application of Lean Six Sigma Methodology: Demonstrate through an internship project, the knowledge and understanding of lean six sigma methodology based on Define, Measure, analyse, improve/develop and control/validate phases (DMAIC/ DMADV).

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 (Accumulated and Averaged)	10
	Practical performance (internal)	15
	Practical Assessment	5
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 (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 - Evolution, classification and layouts of 2 and 3 wheelers, 2 and 3 wheel automotive industry in India and Rest of World, recent developments, electrical vehicle technology and developments for 2 and 3 wheelers. Aerodynamics of 2 and 3 wheelers origin of forces and moments, lateral stability, methods to calculate force and moments, stability under cross winds, dirt accumulation on vehicles, add-ons to improve handling and stability. Instrumentation for two and three wheelers measurement of force, torque, pressure power, temperature, fluid flow, vibration, rotational speed, velocity, acceleration and angular motion, IS code for engine testing, instrumentation for performance testing on engine, R&D, noise, vibration, in cylinder gas flow, flame temperature, dynamic cylinder pressure. Maintenance need, classification, general service procedures for different types of vehicle, study on basic and special service tools. Maintenance fundamentals for engine, engine subsystems, clutch, rear axle, shaft, bearings, differential assemblies, steering systems, braking systems, suspension, tyres, brakes – typical faults, their identification and diagnosing methods. Servicing of electrical components like batteries, charging system, starting system, body electricals – diagnosing using scan tools, Introduction to body repairs like panel beating, tinkering, soldering, polishing and painting Lab: Workshop operations, workshop safety, first aid, general engine service, fuel delivery adjustments for max. power, max. fuel economy, clutch – general check, adjustment and service including clutch play, service and inspection of steering, braking systems, wheels – alignment, balance, removal and fitting of tyres, tyre wear, rotation and inspection, transmission systems – chain drives – slack and lubrication, fundamentals of vehicle washing, delivery checklists etc. Vehicle electrical – replacement, of head lamps, turning indicators, tail lamp, basic wiring, battery installation and removal, installation and removal of vehicle accessories like indicator buzzers, horn, horn tuning, hands-on techniques like soldering, polishing, painting.

Lecture Plan:

F. Text Books

T1. Dhruv. U. Panchal, Two and Three Wheeler Technology, (2e), PHI Learning Private Limited, 2015

T2. K. K. Ramalingam, Two Wheelers, (2e), Scitech Publications (India) Pvt. Ltd., 2014

G. Reference Books

R1. Amitosh De, Vehicle Dynamics, (1e), Galgotia Publications Pvt. Ltd., 2011

R2. P.M. Heldt, Automotive Chassis, Chilton and Co, 1987.

R3. G.B.S. Narang, Automobile engineering, Khanna Publications, N

H. Lecture Plan:

Lecture No.	Topics	Session Outcomes	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction	To acquaint and clear teachers expectations and understand student expectations	Lecture	NA	NA
2,3	Evolution	Origin of two and three wheeled vehicle	Lecture	1554.1	Home Assignment Class Quiz
4,5	Classification and layouts of 2 and 3 wheelers	Explain the classification of two and three wheeled vehicle	Lecture	1554.1	
6,7,8	Electrical vehicle technology and developments for 2 and 3 wheelers	How electrical technology replace the conventional technology from two and three wheel vehicle	Lecture	1554.2	
8,9,10,11	Aerodynamics of 2 and 3 wheelers	Explain the forces act to restrict the performance of vehicle	Lecture	1554.3	Home Assignment Class Quiz
12,13, 14,15,16,	Instrumentation for two and three wheelers	Testing parameter to improve efficiency for two and three wheeled vehicle		1554.2	
17,18,19,20,21, 22,	Maintenance procedure for two and three wheeled vehicle	Service method and maintenance schedule for all components	Lecture	1554.4	
23,24,25,26, 27,	Fault diagnosis for two and three wheeled vehicle	Explain procedure to find out the fault and how do remedy fault	Lecture Flipped Classroom	1554.4	Home Assignment Class Quiz
28,29,30, 31,32,	Servicing of electric components	Explain the proper servicing for electric component for two wheeler	Lecture Flipped Classroom	1554.4	
33,34,35,36,	Introduction to body repairs	Explain the procedure for the body repairing	Lecture	1554.3	Presentation of Ppt developed by students
37,38,	Home assignment for two wheeler presentation	Discussion on different types of two wheeler technology	Flipped Classroom	1554.2	
39,40	Home assignment for three wheeler presentation	Discussion on different types of three wheeler technology	Flipped Classroom	1554.2	
Lab Modules					

1	Overhaul and assembly and disassembly of clutch system for two and three wheeled vehicle
2	Overhaul and assembly and disassembly of steering system for two and three wheeled vehicle
3	Overhaul and assembly and disassembly of brake system for two and three wheeled vehicle
4,5	Overhaul and assembly and disassembly of transmission system for two and three wheeled vehicle
6	Overhaul and assembly and disassembly of suspension system for two and three wheeled vehicle
7	Procedure for servicing and washing of two wheeler and three wheeler vehicle
8,9,10	Overhaul and assembly and disassembly of engine system for two and three wheeled vehicle
11	Procedure for servicing of electric component for two and three wheelers
12	Testing the performance of two wheeler using two wheeler chassis dynamometer

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
AU 1554.1	Classify types the different types of two wheeler and three wheeler for their significant used.	**3**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**2**		**3**	
AU 1554.2	Compute aerodynamic and gyroscopic effect over the two and three wheeled vehicle	**1**	**2**	**0**	**1**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**2**		**1**	
AU 1554.3	Explain various types of component used in two or three wheeled vehicle.	**2**	**1**	**0**	**1**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**1**		**2**	
AU 1554.4	Learn assemble and disassembly of two and three vehicle engine.	**0**	**0**	**0**	**2**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**3**		**3**	

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MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Automobile Engineering
Course Hand-out

Materials and Manufacturing of Automobile components | AU 1555 | 4 Credits | 3 1 0 4

Session: Jul 19 – Dec 19 | Faculty: Dr. Vinod Yadav | Class: Department Elective

A. Introduction: This course is offered by Dept. of Automobile Engineering for fifth semester students. This course provides knowledge of different materials in the design and manufacturing of different motor vehicle bodies and components. Materials for automotive components brings together a wealth of information on automotive materials technologies to provide designers and engineers with both a solid grounding and a quick reference to inform their material choice. This course is a complete stuff of different materials for vehicles. Students are expected to have background knowledge of materials and their basic properties.

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

[1555.1]. Express the knowledge about materials and their alloys, like low alloy steels and high alloy steels and others for automobiles.

[1555.2]. Application and the use of non-metallic materials such as composites, ceramics and polymers in automobiles.

[1555.3]. Establish selection criteria and recommend the material for automotive components (both electronic and other body parts) on the basis of economic condition, design ability, manufacturability, feasibility analysis and environmental conditions.

[1555.4]. Analyse the application of computer aided selection and surface treatments and welding processes for various automotive parts such as body panel and emission control devices.

[1555.5]. Analyse the application of advanced manufacturing processes such as prototype manufacturing like RPT and 3-D manufacturing etc. in automobile industry to develop advanced skills.

PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

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

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

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

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

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

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[PSO.1]. **Autotronics and Electric Vehicle Technology:** Apply knowledge of electrical and electronics engineering for providing automobile engineering solutions

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C. 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)	10
	Lab (Internal Assessment)	15
	Lab Evaluation (External Assessment)	5
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.	

D. SYLLABUS

Introduction Classes of engineering materials, Selection strategy, Attribute limits and Material indices, structural index Selection procedure: process - types of design, requirements, Material attributes, processing. Design processes and their influence on design, Process attributes, Systematic process selection, Process selection diagrams, cost, Energy consumption for production, Material costs, Availability, Recyclability, Environmental consideration. Computer aided selection; **Materials for Automotive components** overview and material selection criteria for body Construction-Such as steel sheet, timber, plastics and GRP. Body trim items-body mechanisms. Vehicle Corrosion-Anticorrosion Methods-Modern painting process procedure. Materials selection for bearings, leaf springs, chassis & frames, Bumper, shock absorbers, wind screens, panels, brake shoes, Disc, wheels, differentials , damping and antifriction fluids, Tyres and tubes; **Electronic Materials** electronic devices meant for engine control, ABS, Steering, Suspension, Sensors, anti-collision, Anti-fog, Head lamps; **Manufacturing processes** Surface treatment – Plastics-

Processing of plastics - Body Panel and emission control devices - Thermoforming and hydro forming, press forming, stretch forming and lamp housing; **Welding** – types, use of Robots in Body weldment, injection molding of instrument panel. Bumpers -reinforced reaction injection molding, tooling and tooling. Manufacture of polymer panels. Manufacturing methods for Vehicle Frame Manufacturing, Wheel drum, Brake drum, Brake shoes, wheel rim and wheel housing manufacturing. Steering systems, shock absorbers. Tire and tube manufacturing, spray painting, powder coating, Prototype Manufacturing - RPT, 3-D Printing, chemical vapour deposition, physical vapour deposition, cryogenic grinding of powders, sealants, sound proof materials, structural adhesives, MMC liners.

E. TEXT BOOKS

1. B P Bhardwaj, "The complete book on production of automobile components and allied products" NIIR project consultancy services, 2014

F. REFERENCE BOOKS

1. Cantor, "*Automotive Engineering: Lightweight, functional and novel materials*" Taylor and Francis, London 2007
2. Gladius Lewis, *Selection of Engineering Materials*, Prentice Hall Inc. USA, 2017
3. *Metals & Alloys in the Unified Numbering System*, 4th ed., Society of Automotive Engineers, 1986

G. Lecture Plan:

Lec No	Topics	Session Objective	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction and objective of the course	To acquaint and clear teachers expectations and understand student expectations	Lecture	NA	NA
2	Classes of engineering materials	Describe various classes of engineering materials and their application in engineering	Lecture	AU 1555.1	In Class Quiz (Not Accounted)
3-4	Selection strategy, Attribute limits and Material indices, Structural index	Identify different strategies for material selection and nomenclature of engineering materials.	Lecture, Activity	AU 1555.1 AU 1555.3	Class Quiz
5-7	Selection procedure: process - types of design, requirements, Material attributes	Explain various processes of different types of design requirements and material attributes.	Lecture, Activity	AU 1555.3	Home Assignment
8	Design processes and their influence on design	Discuss various design processes and how does each process affect the design.	Lecture	AU 1555.3	In Class Quiz
9	Process attributes	Describe various process attributes for material selection.	Lecture, team activity	AU 1555.3	In Class Quiz
10-11	Process selection diagrams, cost, Energy consumption for production, Material costs	Illustrating the importance and need of parameters such as material cost and energy consumption in material selection process	Lecture	AU 1555.3	Class Quiz
12-13	Availability, Recyclability, Environmental consideration	Discussing the environmental and social aspects to be considered in material selection process.	Flipped Class, Group Discussion	AU 1555.1 AU 1555.3	Home Assignment Class Quiz
14	Computer aided selection	Analysing the role of computers in manufacturing process used in automotive industry.	Lecture, Activity	AU 1555.5	Class Quiz
15	Overview and material selection criteria for body construction	To establish basic understanding of various material selection criterion for construction of vehicle body.	Lecture	AU1555.3	Class Quiz
16-17	Steel sheet, timber, plastics and GRP	Introducing to the use of non-metallic	Lecture	AU1555.2 AU1555.3	Class Quiz

		materials in automobile construction.			
18	Body trim items-body mechanisms	Understand various mechanisms used for body trimming process in automobile industry.	Lecture, Activity	AU1555.3	Class Quiz
19-20	Vehicle corrosion-Anticorrosion methods-Modern painting process procedure	Understand the chemical properties of corrosion and analyse significance of anti-corrosive methods used in automobile industry to avoid the harmful impact of corrosion.	Lecture, Activity	AU1555.4	Class Quiz
21	Materials selection for bearings, leaf springs	Identify criteria of material selection for manufacturing of bearings and springs.	Lecture, Flipped Classroom	AU1555.3	Class Quiz
22	Chassis & frames	Identify material selection criteria for manufacturing of vehicle chassis and frames along with their functions	Flipped Class	AU1555.3	Class Quiz
23	Bumper, shock absorbers	Identify material selection criteria for manufacturing of bumper and shock absorbers along with their functions.	Flipped Class	AU1555.3	Class Quiz
24	Wind screens, panels	Identify material selection criteria for manufacturing of wind screens and panels along with their functions.	Flipped Class	AU1555.2 AU1555.3	Class Quiz
25	Brake shoes, Disc wheels,	Identify material selection criteria for manufacturing of brake shoes and disc wheels along with their functions	Flipped Class	AU1555.3	Class Quiz
26-27	damping and antifriction fluids, Tyres and tubes	Illustrate the use of damping and anti-friction fluids. Understand the selection criterion for tyres and tubes of automobiles.	Flipped Class	AU1555.2 AU1555.3	Class Quiz
28	Electronic devices meant for engine control	Identify material selection criteria for engine control unit	Flipped Class	AU1555.2 AU1555.3	Class Quiz

		along with their functions			
29-30	ABS, Steering, Suspension	Identify material selection criteria for manufacturing of ABS, steering and suspension along with their functions.	Flipped Class	AU1555.2 AU1555.3	Class Quiz
31-32	Sensors, anti-collision, Anti-fog, Head lamps.	Understand different types of sensors used in an automobile and identify the criterion for selection of materials used in their manufacturing.	Flipped Class	AU1555.2 AU1555.3	Class Quiz
33-34	Surface treatment	Explain the process and application of surface treatment in automotive industry.	Lecture	AU1555.5	Class Quiz
35	Processing of plastics - Body Panel	Illustrate manufacturing processes used for plastics to make Body panels	Flipped Classroom	AU1555.5	Class Quiz
36	Processing of plastics - emission control devices	Discuss various emission control devices and their key design features along with manufacturing processes used in making ECU	Flipped Classroom	AU1555.5	Class Quiz
37	Thermoforming and hydro forming	Explaining the basics of thermoforming and hydro forming process and discuss their applicability	Flipped Classroom	AU1555.5	Class Quiz
38	Press forming and Stretch forming	Explaining the basics of press forming stretch forming process and discuss its applicability	Flipped Classroom	AU1555.5	Class Quiz
39	lamp housing	Discuss various parts of a lamp housing and materials used to manufacture them.	Lecture	AU1555.5	Class Quiz
40-41	Types of Welding	Explain various types of welding and applicability criteria in different manufacturing different parts of automobile.	Flipped Classroom	AU1555.5	Class Quiz
42	Use of Robots in Body weldment	Demonstrate the use of robots in weldment of different body parts of an automobile.	Flipped Classroom	AU1555.5	Class Quiz

43	Injection moulding of instrument panel, Bumpers	Detailed discussion on use of injection moulding process for manufacturing instrument panel.	Lecture	AU1555.5	Class Quiz
44	Reinforced reaction injection moulding, tooling	To understand the use and application of reinforced reaction injection moulding in automobile parts.	Lecture, Activity	AU1555.5	Class Quiz
45	Manufacturing of polymer panels	Identify the manufacturing process used for making polymer panels	Lecture, Activity	AU1555.5	Class Quiz
46	Manufacturing methods for Vehicle Frame Manufacturing	Discuss different methods and selection criteria used for manufacturing vehicle frame.	Lecture, Group Discussion	AU1555.5	Class Quiz
47-48	Manufacturing methods Wheel drum, Brake drum, Brake shoes	Discuss different manufacturing methods used to make wheel drum, brake drum and brake shoes along with their functions.	Flipped Classroom	AU1555.5	Class Quiz
49	Manufacturing methods wheel rim and wheel housing manufacturing.	Discuss different manufacturing methods used to make wheel rim and wheel housing along with their functions.	Flipped Classroom	AU1555.5	Class Quiz
50	Manufacturing methods Steering systems, shock absorbers	Discuss different manufacturing methods used to make steering systems and shock absorbers along with their functions.	Flipped Classroom	AU1555.5	Class Quiz
51	Tyre and tube manufacturing	Discuss the different types of tyres and tubes used for vehicles with differing applications	Flipped Classroom	AU1555.5	Class Quiz
52	Prototype Manufacturing - RPT	Explaining the basics of prototype manufacturing and its advantages over conventional manufacturing processes. Introduction to RPT manufacturing	Lecture, expert lecture	AU1555.6	Class Quiz
53	3-D Printing	Understanding the process of 3-D printing and its application	Lecture, expert lecture	AU1555.6	Class Quiz

54	Chemical vapour deposition, Physical vapour deposition	Classify various chemical and physical deterioration phenomena acting on vehicles and their parts.	Lecture, Class activity	AU1555.4	Class Quiz
55	Sealants, sound proof materials, structural adhesives, MMC liners	Identify the use and material selection criteria for various non-metallic parts such as sealants, sound proof materials.	Lecture	AU1555.2 AU1555.4	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
AU 1555.1	Express the knowledge about materials and their alloys, like low alloy steels and high alloy steels and others for automobiles.	1		2			1	1								
AU 1555.2	Application and use of non-metallic materials such as composites, ceramics and polymers in automobiles.	1		2			1	1								
AU 1555.3	Establish selection criteria and recommend the material for automotive components (both electronic and other body parts) on the basis of economic condition, design ability, manufacturability, feasibility analysis and environmental conditions.			3				1			1					
AU 1555.5	Analyse the application of computer aided selection and surface treatments and welding processes for various automotive parts such as body panel and emission control devices.			3				2								
AU 1555.6	Analyse the application of various manufacturing processes such as prototype manufacturing like RPT and 3-D manufacturing etc. in automobile industry.			1		2										

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MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Automobile Engineering
Course Hand-out

Vehicle Dynamics and Stability Control | AU 1705 | 4 Credits | 3 0 1 4

Session: Jul 19 – Dec 19 | Faculty: Satish Namdev | Class: VII Sem

A. Introduction: This course is offered by Dept. of Automobile Engineering for seventh semester students. VDSC as a core course that helps students who wish to pursue their career in R&D automotive as well as higher studies in field of Automotive Engineering. This course offers a knowledge in different kind of forces and their effect on moving vehicle. This course is a complete stuff about various factors of vehicle handling. Students are expected to have background knowledge on basic mechanics like fundamental of forces etc.

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

1. Describe and analyse various resistance and their effect on engine performance as well as moving vehicle.
2. Describe and analyse vehicle aerodynamic forces and their effect on vehicle and how minimize them.
3. Describe various vehicle handling factors for stability and controlling of vehicle while driving it.
4. Evaluate various factors those affect vehicle dynamics and stability.
5. Describe, analyse and compute the factors are involved with road testing, road performance and fuel consumption which enhance employability skill.

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

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PROGRAM SPECIFIC OUTCOMES

[PSO.1]. **Autotronics and Electric Vehicle Technology:** Apply knowledge of electrical and electronics engineering for providing automobile engineering solutions

[PSO.2]. **Alignment to Super Qualification packs of ASDC:** Demonstrate knowledge and performance criteria as defined by ASDC super qualification packs for R&D or Quality or Service Engineering

[PSO.3]. **Application of Lean Six Sigma Methodology:** Demonstrate through an internship project, the knowledge and understanding of lean six sigma methodology based on Define, Measure, analyse, improve/develop and control/validate phases (DMAIC/ DMADV).

D. Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Open/Closed Book)	15
	Sessional Exam II (Open/Closed Book)	15
	In class Quizzes and Assignments, Activity feedbacks (Accumulated and Averaged)	10
	Practical internal	15
	Practical External	05
End Term Exam (Summative)	End Term Exam (Open/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:

Performance of cars and light trucks: Vehicle drag-deformation of the wheel, deformation of the ground, Total resistance to a moving vehicle- air, rolling and grade resistance, power for propulsion, traction and tractive effort, Road performance curves- acceleration, gradiability and drawbar pull, acceleration time and elasticity, fuel consumption and fuel economy, strategy for lowest fuel consumption, factors affecting fuel economy. **Aerodynamic forces:** Aerodynamic drag, drag components, drag coefficient, aerodynamic aids, aerodynamic side force, lift force, pitching moment, yawing moment, rolling moment, cross wind sensitivity.

Vehicle handling: Steering angle, cornering force, low speed turning, high speed cornering, suspension effects on cornering, self-righting torque, slip angle, over steer, under steer, steady state cornering, driving torques on steering, effect of camber, camber thrust, transient effects in cornering.

Stability of vehicles: Distribution of weight (Three wheeled and four wheeled vehicles), stability of a vehicle on a slope, Dynamics of vehicle running on a banked track, Stability of a vehicle taking a turn, Braking requirements, stopping distance, braking efficiency, work done in braking, tyre adhesion, braking of vehicles.

Road testing methods: Measurement of aerodynamic drag force in a coast – down test, cross wind tests, engine cooling road test, wind noise measurement on the road.

F. Text Book:

1. N.K. Giri, Automobile Mechanics, Khanna Publishers, 2001.
2. Thomas D. Gillespie – Fundamentals of road vehicles - SAE, 1992

G. References:

1. Wolf- Heinrich Hucho – Aerodynamics of road vehicles, SAE
2. J.G. Giles- steering, suspension and tyres, Wildlife books Ltd, London, 1968
3. P.M. H- Automotive chassis, Chilton Co., New York, 1952

H. Lecture Plan:

Lecture No	Topics	Session Objective	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction and Course Hand-out briefing	To acquaint and clear teachers expectations and understand student expectations	Lecture	NA	NA
2-3	**Performance of cars and light trucks:** Vehicle drag-deformation of the wheel, deformation of the ground, Total resistance to a moving vehicle- air, rolling and grade resistance,	**Explain effect of various types of resistance on an automobile**	Flipped Classroom	1705.1	Class Quiz (Not Accounted)

4-5	Power for propulsion, traction and tractive effort, Road performance curves- acceleration, gradiability and drawbar pull,	**Explain road performance curve and required power for propulsion an automobile**	Lecture	1705.1	Home Assignment
5-7	acceleration time and elasticity, fuel consumption and fuel economy, strategy for lowest fuel consumption, factors affecting fuel economy	**Identify strategies and discuss factors to improve fuel economy of an automobile**	Lecture	1705.1	In Class Quiz
8-10	Numerical Problem	**Solved case study based problem**	Lecture	1705.1	Home Assignment
11	**Aerodynamic forces:** Aerodynamic drag, drag components, drag coefficient,	**Explain various types of aerodynamic forces**	Flipped Classroom	1705.2	Home Assignment Class Quiz
12-14	Aerodynamic aids, aerodynamic side force, lift force, pitching moment, yawing moment, rolling moment, cross wind sensitivity,	**Describe various types of aerodynamic aids used for reducing air resistance**	Flipped Classroom	1705.2	Class Quiz
15-16	Numerical problems	**Solved case study based problem**	Lecture/Activity	1705.2	Class Quiz
17-18	**Vehicle handling:** Steering angle, cornering force, low speed turning, high speed cornering, suspension effects on cornering,	**Explain significance of vehicle handling and various systems used for improving handling of vehicle**	Lecture	1705.3	Class Quiz
19-20	self-righting torque, slip angle, over steer, under steer, steady state cornering,	**Describe various components of vehicle handling system**	Lecture	1705.3	Class Quiz (Not Accounted)
21-23	Driving torques on steering, effect of camber, Camber thrust, transient effects in cornering.	**Explain significance of vehicle handling and various systems used for improving handling of vehicle**	Lecture/ Activity	1705.3	Class Quiz
24-26	Numerical problems	**Solved case study based problem**	Lecture	1705.3	Home Assignment
27	**Stability of vehicles:** Distribution of weight (Three wheeled and four wheeled vehicles),	**Explain effect of different types of factors considered in weight distribution and calculate reaction on each wheel**	Lecture	1705.4	Home Assignment
28	Distribution of weight (Three wheeled and four wheeled vehicles),	**Calculate support reaction on each wheel**	Lecture	1705.4	Class Quiz
29-30	stability of a vehicle on a slope, Dynamics of vehicle	**Calculate support reaction on each wheel**	Lecture	1705.4	Home Assignment

	running on a banked track,				
31-33	Stability of a vehicle taking a turn, Braking requirements, stopping distance, Braking efficiency,	**Explain work done during braking of vehicle**	Lecture	1705.4	Class Quiz
34-35	Work done in braking, Tyre adhesion, braking of vehicles.	**Explain work done during braking of vehicle**	Lecture	1705.4	Home Assignment
35-38	Numerical problems	**Solved case study based problem**	Activity	1705.5	Class Quiz
39	**Road testing methods:** Measurement of aerodynamic drag force in a coast – down test,	**Explain different types of techniques used for measuring drag**	Lecture	1705.5	Class Quiz
41-42	Cross wind tests, engine cooling road test, Wind noise measurement on the road.	**Discribe different types of test used for measuring noise level**	Lecture	1705.5	Class Quiz

J. Course articulation matrix ;- (Mapping of COs and 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
AU 1705.1	Describe and analyse various resistance and their effect on engine performance as well as moving vehicle.	3												1		
AU 1705.2	Describe and analyse vehicle aerodynamic forces and their effect on vehicle and how minimize them.				2			2								
AU 1705.3	Describe various vehicle handling factors for stability and controlling of vehicle while driving it.		1							2					2	
AU 1705.4	Evaluate various factors those affect vehicle dynamics and stability.						2		2	1				2		
AU 1705.5	Describe, analyse and compute the factors are involved with road testing, road performance and fuel consumption which enhance employability skill.		2				2					3			1	

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering
Department of Automobile Engineering
Course Hand-out
Electrical And Hybrid Vehicle | Code: AU-1707 | 3 Credits | 3 0 2 4
Session: Jul.19 – Nov.19 | Faculty: Dr. Ashish Malik | Class: VII semester

A. Introduction:

This course is offered by Dept. of Automobile Engineering as a core subject, targeting students who wish to pursue research & development in industries or higher studies in field of Electric and Hybrid Vehicles and upcoming market for retrofit of existing IC engine vehicles with electric motors. Offers in depth knowledge about working of an Electric Vehicle by covering study of Vehicle Fundamentals of EVs and its various components. Lithium-ion batteries are covered in detail in relevance to EVs. The course gives an introductory level knowledge on working fundamentals of different electric motors (AC and DC machines, 3 phase induction motors, SRMs), motor controllers and control techniques, electric vehicle drive train, regenerative braking and different types of hybrid vehicles. Students are expected to have background knowledge on basic vehicle working fundamentals for a better learning.

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

[1707.1]. Understand the vehicle mechanics and effects of different forces acting on a moving vehicle.

[1707.2]. Describe the working of an EV and its components and differentiate it from an IC engine based vehicle.

[1707.3]. Understand the differences between various types of batteries and choose most optimum battery for an EV based on design parameters.

[1707.4]. Interpret and illustrate the working of different types of electrical machines and motors.

[1707.5]. Recognize different configurations of Hybrid vehicles and the working and performance based on different powertrains in a hybrid vehicle.

[1707.6]. Fabricate Electric vehicle with retro fitment and become an entrepreneur and measure its performance enhancing their employability skills.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

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

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

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

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

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

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

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

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

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

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

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

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

PROGRAM SPECIFIC OUTCOMES

[PSO.1]. **Autotronics and Electric Vehicle Technology:** Apply knowledge of electrical and electronics engineering for providing automobile engineering solutions

[PSO.2]. **Alignment to Super Qualification packs of ASDC:** Demonstrate knowledge and performance criteria as defined by ASDC super qualification packs for R&D or Quality or Service Engineering

[PSO.3]. **Application of Lean Six Sigma Methodology:** Demonstrate through an internship project, the knowledge and understanding of lean six sigma methodology based on Define, Measure, analyse, improve/develop and control/validate phases (DMAIC/ DMADV).

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	15
	Sessional Exam II (Closed Book)	15
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100

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

E. Syllabus:

Electric Vehicles fundamentals - Introduction, Vehicle dynamics – Roadway fundamentals, vehicle kinetics, Dynamics of vehicle motion - Propulsion System Design. IC engine versus EVs. **Battery Basics: -** Types, Parameters – Capacity, C-rate, SOC, DOD. Technical characteristics of Lithium Ion and Lead-Acid batteries. Battery pack Design, Thermal issues in batteries.

Electrical Machines (DC & AC): Motor and Engine rating, Requirements, DC machines (BLDC & BDC), Three phase A/c machines, Induction machines, permanent magnet machines, switched reluctance machines. Motor Power controllers. Thermal issues in motors.

Solar Powered & Hybrid Electric Vehicles: Layout, advantage, limitations, Specifications and System component. Hybrid Types – series, parallel and mild parallel configuration – Design – Drive train, sizing of components

Electric Vehicle Drive Train -Transmission configuration, Components – gears, differential, clutch, brakes regenerative braking, motor sizing.

Fuel Cell Powered Vehicles: Introduction, Open Circuit voltage, Operational cell voltages, Types- PEM fuel cells, Alkaline Electrolyte, Direct Methanol fuel cell, Medium and high temperature and fuel types, fuel cell stacks, Delivering fuel cell power, Integrated Air supply and humidification concepts for fuel cell systems, Fuel cell Auxiliary systems. Automotive Application of Fuel Cells

LAB EXPERIMENTS: Battery Monitoring System, Battery Charger for Lead Acid battery and Li-ion Battery, BLDC Motor Torque and Load testing on a dyano. Design a Motor Controller, Series and parallel Hybrid Powertrain. Analysis of EV driving parameters, driving uphill/ downhill, different gear lever positions, energy consumption by electric motor, regenerative braking scenarios, etc. using De Lorenzo DL AM22 Hybrid and Electric Simulator. Thermal simulation, capacity fade analysis using COMSOL Multiphysics software.

F. Text Book:

- M. Ehsani, Y. Gao and Ali Emadi, *Modern Electric, Hybrid Electric and Fuel Cell Vehicles*, 2nd Edition, CRC Press, London, 2010.

G. Reference Books:

- C. Glaize and S. Genies, *Lithium Batteries and Other Electrochemical Storage Systems*, 1st Edition, Wiley, New York, 2013.
- Hughes, *Electric Motors and Drives*, 3rd Edition, Elsevier Publication, Great Britain, 2006.
- J. Larminie and J. Lowry, *Electric Vehicle Technology Explained*, Wiley, England, 2012.

H. Lecture Plan:

Lec No	**Topics**	**Session Outcome**	**Mode of Delivery**	**Mode of Assessing the Outcome**
1	Introduction and Course Hand-out briefing	To acquaint and clear teachers expectations and understand student expectations	Lecture	NA
2	Components of a common Vehicle	Recall working of a vehicle (cars, trucks, etc)	Flipped Classroom	In Class Quiz (Not Accounted)
3,4	Vehicle mechanics and Roadway fundamentals	Identify different forces acting on a vehicle	Lecture	In Class Quiz
5,6	Vehicle kinetics and Dynamics of vehicle motion	Explain the effects of different forces on different components of vehicle	Lecture	In Class Quiz
7,8	Power train design considerations (normal vehicle vs electric vehicle)	Recall the powertrain design in existing IC engine vehicles and comparison with electric vehicles	Lecture	Home Assignment
9	Battery types and basics	Recall the different batteries used in electronic gadgets.	Activity (Think Pair Share)	Class Quiz
10	Battery Design Parameters – Capacity, Discharge rate, State of charge, state of Discharge, Depth of Discharge,	Explain the different design parameters for various types of batteries.	Lecture	Class Quiz
11, 12	Technical characteristics of Lead Acid	Recall Lead acid batteries being used in vehicles and interpret the technical characteristics.	Flipped Class	Class Quiz
13, 14, 15	Technical characteristics of Lithium Ion Batteries (Li-polymer, LiFePO4, Li-Titanate, $LiMn_2O_4$)	Explain the detail about Lithium Ion batteries and their characteristics	Lecture	Class Quiz
16	Design Considerations of Battery Pack – Thermal Management, BMS	Designing the battery pack on basis of requirements ad design of cells available in the market	Activity (Think Pair Share)	Home Assignment

17	Dc & Ac Electrical Machines and their types.	Recall the different type of electrical machines used.	Lecture	Class Quiz
18, 19	Electric Motors and their working.	Explain the working of electric motors and Analyse their performanc	Lecture	Class Quiz
20	DC machines,	Explain the characteristics of different direc current motors used in EVs. Locate different DC motos in different brands of EVs	Lecture, Activity	Class Quiz
21, 22	Three phase A/c machines,	Explain the characteristics of Alternating Current motors used in EVs. Locate different DC motos in different brands of EVs	Lecture, Activity	Class Quiz
23, 24	permanent magnet machines,	Recall the working of PM machines being commonly used and explain their characteristics	Lecture	Class Quiz
25	Switched reluctance machines.	Recall the working of SRM machines being commonly used and explain their characteristics	Lecture	Class Quiz
26	Induction machines,	Recall the working of Induction Motors being commonly used and explain their characteristics	Lecture	Home Assignment
27	Electric Vehicle Drive Train -	Locate the drive train components in existing EVs and explain the characteristics of drive train	Lecture, Activity	Class Quiz
28, 29	Transmission configurations and components	Explain the working of a transmission ad characteristics of various gears and differentials	Lecture	Class Quiz
30	gears & differential	Explain the working and design of clutches used in EVs.	Lecture	Class Quiz
31, 32	Clutches and Brakes	Recall the components and working of clutches and braking components	Lecture	Class Quiz
33	Regenerative braking	Explain the characteristics of regenerative braking.	Lecture	Home Assignment
34	Hybrid Electric Vehicles	Recall the various types of Hybrid Electric vehicles.	Activity (Think Pair Share)	Class Quiz
35	Types of Hybrid Electric Vehicles	Explain the working of different types of configuration in hybrid vehicles	Lecture	Class Quiz
36, 37, 38	Hybrid Configurations- series, parallel and mixed	Explain the characteristics and components in series and parallel configurations	Lecture	Class Quiz
39	Design of Drive train components	Explain the characteristics of drive train involved hybrid vehicles	Lecture	Class Quiz
40	Sizing for hybrid vehicles components for varied applications	Recall and Explain the sizing criteria and design of components based on varied applications	Lecture	Home Assignment, Class Quiz

I. Course articulation matrix: -

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
AU 1707.1	Understand the vehicle mechanics and effects of different forces acting on a moving vehicle.	3	2						1	1				2	1	
AU 1707.2	Describe the working of an EV and its components and differentiate it from an IC engine based vehicle.		2	2	2					2				2	1	
AU 1707.3	Understand the differences between various types of batteries and choose most optimum battery for an EV based on design parameters		2		2					2				2	1	
AU 1707.4	Interpret and illustrate the working of different types of electrical machines and motors.	2	2						1	2				2	1	
AU 1707.5	Recognize different configurations of Hybrid vehicles and the working and performance based on different powertrains in a hybrid vehicle	2	2						1	2				2	1	
AU 1707.6	Fabricate Electric vehicle with retro fitment and become an entrepreneur and measure its performance enhancing their employability skills.		2	3	2					2				2	1	

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile, Mechanical and Mechatronics

Department of Automobile Engineering

Course Hand-out Jul 19- Dec 19

Earth moving Equipment | AU 1760 | 3 Credits | 2 0 2 3

A. **Introduction:** This course is offered as an elective course to the students of IV Year B Tech Automobile Engineering. This course offers in depth knowledge including various off road vehicles, transport equipment, Tractors, Earth moving machines etc. Students are expected to have background knowledge on automobile engineering, IC engines, two and three wheelers, chassis system and transmission system, and be familiar with Vehicle body engineering for better learning.

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

[1760.1] Classify types of off road vehicles.

[1760.2] Describe various types of transport equipment, their principles and uses in industry.

[1760.3] Describe various types of tractors, their principle, system and their uses.

[1760.4] Describe various types of earth moving machines, their principle, system and their uses which leads to 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

[PSO.1]. Autotronics and Electric Vehicle Technology: Apply knowledge of electrical and electronics engineering for providing automobile engineering solutions

[PSO.2]. Alignment to Super Qualification packs of ASDC: Demonstrate knowledge and performance criteria as defined by ASDC super qualification packs for R&D or Quality or Service Engineering

[PSO.3]. Application of Lean Six Sigma Methodology: Demonstrate through an internship project, the knowledge and understanding of lean six sigma methodology based on Define, Measure, analyse, improve/develop and control/validate phases (DMAIC/ DMADV).

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 (Accumulated and Averaged)	10
	Application based project (internal)	15
	Project Assessment	5
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 (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:

Classification and requirements of off road vehicles: Land clearing machines Earth moving machines Scrapers and graders Shovels and ditcher's Power plants, chassis and transmission, multi axle vehicles. **Transport equipment;** Powered equipment, Tractors and Trollies, Trailers, Platform lift trucks, Fork lift trucks, containers and Supports. Hauling equipment: Types of dump trucks, On-high way vehicles, off high way vehicles. Hoisting equipment: Jacks, truck mounted crane, Crawler crane, Outriggers. **Tractors and tractors units:** Tractors in earth moving Applications of tractors, Rating of Tractors, Wheeled and Crawler tractor, recent trends in tractor design, power shift transmission and final drive in caterpillar tractor. Motor grader, recent trends, control mechanism of a caterpillar motor grader. **Earth moving machines:** Bulldozers, cable and hydraulic dozers. Crawler track, running and steering gears, scrapers, drag and self-Powered types - dump trucks and dumpers - loaders, single bucket, multi bucket and rotary types - power and Capacity of earth moving machines.

Lab: Hydraulic trainer explains the hydraulic principle used in crawler tractor, power shift transmission and final drive**.** Pneumatic trainer explains the circuit used in pneumatic brake system used in heavy vehicle.

F. **Text Book:**

1. Abrosimov. K. Bran berg.A. And Katayer.K., *Road making Machinery,* MIR Publishers, Moscow, 1971.

G. **Refrences:**

1. Wang.J.T. *Theory of Grand vehicles,* John Wiley & Sons, New York, 1987.
2. *Off the road wheeled and combined traction devices* - Ashgate Publishing Co. Ltd. 1998
3. R.L. Peurifoy, *Construction Planning Equipment and Methods, McGraw Hill Publishers, 1956*
4. Mahesh Varma, *Construction Equipment and its Planning and* Applications, Metropolitan Books Co., Delhi, 2004

H. Lecture Plan:

Lecture No.	Topics	Session Objective	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	**Introduction**	To acquaint and clear teachers expectations and understand student expectations	Lecture	NA	
2	**Classification and requirements of off road vehicles:** Land clearing machines	Classify off road vehicles Describe land clearing machines	Lecture	[1760.1]	Home Assignment Class Quiz Mid term End term
3	chassis and transmission	Describe chassis and transmission system of off road vehicles	Lecture	[1760.1]	
4	multi axle vehicles	Describe various multi axle vehicles	Lecture Flipped Classroom	[1760.1]	
5	**Transport equipment;** Powered equipment	Classify transport equipment	Lecture	[1760.2]	Home Assignment Class Quiz Mid term End term
6	Tractors and Trollies	Describe Tractors and Trollies and their principle, uses etc.	Lecture	[1760.2]	
7,8	Trailers, Platform lift trucks, Fork lift trucks, containers and Supports	Describe Trailers, Platform lift trucks, Fork lift trucks, containers and Supports	Lecture Flipped Classroom	[1760.2]	
9,10	**Hauling equipment:** Types of dump trucks, On-high way vehicles, off high way vehicles	Classify Hauling equipment Describe dump truck, on highway and off highway vehicles	Lecture Flipped Classroom	[1760.2]	
11,12	**Hoisting equipment:** Jacks, truck mounted crane, Crawler crane, Outriggers	Classify Hoisting equipment Describe jack mounted crane, crawler crane, outriggers	Lecture Flipped Classroom	[1760.2]	

13	**Tractors and tractors units:** Tractors in earth moving Applications of tractors, Rating of Tractors	Describe role of tractors in earth moving, application and rating of tractors Bernoulli's equation	Lecture	[1760.3]	Home Assignment Class Quiz Mid term End term
14	Wheeled and Crawler tractor	Describe Wheeled and Crawler tractor	Lecture	[1760.3]	
15,16	recent trends in tractor design	Recall tractors, and describe recent trends in tractor design	Lecture Flipped Classroom	[1760.3]	
17,18	Power shift transmission and final drive in caterpillar tractor	Recall tractors, and describe transmission and final drive of caterpillar tractor	Lecture Flipped Classroom	[1760.3]	
19,20	Motor grader, recent trends, control mechanism of a caterpillar motor grader.	Describe grader and its control mechanism	Lecture Flipped Classroom	[1760.3]	
21	**Earth moving machines:** Bulldozers	classify Earth moving machines, describe Bulldozers	Lecture	[1760.4]	Home Assignment Class Quiz End term
22,23	Cable and hydraulic dozers	Describe Cable and hydraulic dozers	Lecture	[1760.4]	
24,25	Crawler track, running and steering gears, scrapers	Describe Crawler track, running and steering gears, scrapers	Lecture	[1760.4]	
26,27	drag and self-Powered types - dump trucks and dumpers - loaders	Describe drag and self-Powered types dump trucks and dumpers, loaders	Lecture Flipped Classroom	[1760.4]	
28,29	Single bucket, multi bucket and rotary types	Describe Single bucket, multi bucket and rotary type's earth moving machines.	Lecture	[1760.4]	
30	Power and Capacity of earth moving machines.	Describe Power and Capacity of earth moving machines.	Lecture	[1760.4]	

Lab Module	
1	Hydraulic principle used in various off road vehicles
2	Hydraulic principle used in various transport equipment, tractors and earth moving machines
3	Pneumatic principle used in various off road vehicles
4,	Pneumatic principle used in various transport equipment, tractors and earth moving machines
5	**Mini project** based on hydraulic and pneumatic principle used in various earth moving machines
6	**Mini project** based on hydraulic and pneumatic principle used in various earth moving machines
7	**Mini project** based on hydraulic and pneumatic principle used in various earth moving machines
8	**Mini project** based on hydraulic and pneumatic principle used in various earth moving machines
9	**Mini project** based on hydraulic and pneumatic principle used in various earth moving machines

10	**Mini project** based on hydraulic and pneumatic principle used in various earth moving machines
11	**Mini project** based on hydraulic and pneumatic principle used in various earth moving machines
12	**Mini project** based on hydraulic and pneumatic principle used in various earth moving machines
13	**Mini project** based on hydraulic and pneumatic principle used in various earth moving machines
14	**Mini project** based on hydraulic and pneumatic principle used in various earth moving machines

I. Course articulation matrix ;- (Mapping of COs and 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
AU [1760.1]	Classify types of off road vehicles.		2						1	2		1				
AU [1760.2]	Describe various types of transport equipment their principles and uses in industry		2	2	3			1	2	2		1				
AU [1760.3]	Describe various types of tractors, their principle, system and their uses.		2	2	3			1	2	2		1				
AU [1760.4]	Describe various types of earth moving machines, their principle, system and their uses.		2	2	3			1	2	2		1				

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Automobile Engineering
Course Hand-out

Manufacturing Quality Management | AU 1761 | 3 Credits | 2 0 2 3

Session: Jul 19 – Nov 19 | Faculty: Dr. Avanish Singh Chauhan | Class: Final Year (Program Elective)

A. Introduction: This course is offered by Dept. of Automobile Engineering for seventh semester students as a program elective course. This course provides knowledge of various quality systems for monitoring and managing process and product quality. It discusses the concepts of inspection and audits conducted for ensuring quality. This course focuses on practical skills required for working in industries/organization. It also provides knowledge of standards and guidelines to be followed for testing and calibration for maintaining manufacturing quality.

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

[1761.1] Understand the ISO standards defining the requirements pertaining to testing and calibration.
[1761.2] Develop skills to conduct audits for inspection of processes and products to monitor process and product quality.
[1761.3] Understand the methods for improving final product quality using FMEA, QFD, etc.
[1761.4] Implement the quality management measures in automotive industry applications.

C. Program Outcomes and Program Specific Outcomes

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

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

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

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

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

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

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

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

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

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

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

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

[PSO.1]. **Autotronics and Electric Vehicle Technology**: Apply knowledge of electrical and electronics engineering for providing automobile engineering solutions

[PSO.2]. **Alignment to Super Qualification packs of ASDC**: Demonstrate knowledge and performance criteria as defined by ASDC super qualification packs for R&D or Quality or Service Engineering

[PSO.3]. **Application of Lean Six Sigma Methodology**: Demonstrate through an internship project, the knowledge and understanding of lean six sigma methodology based on Define, Measure, analyse, improve/develop and control/validate phases (DMAIC/ DMADV).

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	10
	Lab Exercises	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, 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 for internal evaluation.	

E. Syllabus

Monitor Process and Product Quality: Process validation methodology followed. Inspection checkpoints for product and process audits. ISO/IEC17025 standard; General requirements for the competence of testing and calibration laboratories. Calibration certificate contents, Standards room parameters and requirements, Dimension validation and testing methods for product. Layout inspection methodology for dimension validation**. Customer Quality Management**: Monitor final product quality; Dock audit checklist, Pre Delivery Inspection, Information flow system followed at customer's end , Improving quality standards of final product, Failure testing done for validation, Inspection check points for NPD, Production, and Dock Audit etc. Testing equipment operational knowledge. Tests performed for product and process parameters maintenance. Failure testing done for validation.

Lab: Prepare a quality plan and comprehensive checklists for product and process audit. Simulate an internal audit for processes and the corresponding products as per ISO/IEC17025. Develop a Control Plan from a PFMEA.

F. Text Books

T1. F.M. Gryna, R. Chua, J.A. Defeo, *Juran's Quality Planning and Analysis*, McGraw Hill Education.

G. Reference Books

R1. J.M. Juran, *Quality Planning and Analysis*, McGraw Hill Publication.

R2. D. Hoyle, *Automotive Quality Systems Handbook*, Butterworth-Heinemann Ltd.

H. Lecture Plan:

Lec. No.	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction to Course and Hand-out briefing	To acquaint and clear teachers expectations and understand student expectations	Discussion	NA	NA
2	Introduction to concept of quality and its importance in manufacturing	Recall concept of quality and its importance in engineering	Lecture	AU1761.1 AU1761.2 AU1761.3 AU1761.4	MTE-I, ETE, Assignments
3	Monitoring product and process quality-inspection checkpoints and process validation method	Understand the monitoring and inspection activities for ensuring product and process quality	Lecture	AU1761.1 AU1761.2	
4, 5	ISO/IEC 17025 standard - General requirements for the competence of testing and calibration laboratories: Scope and normative references	Explain the usage and applicability of ISO/IEC 17025 standard for calibration requirements	Lecture	AU1761.1	
6, 7	ISO/IEC 17025 standard: Management requirements	Understand the managerial requirements of ISO/IEC 17025 standard	Lecture, Activity	AU1761.1	
8, 9	ISO/IEC 17025 standard: Technical requirements	Understand and explain the technical requirements of ISO/IEC 17025 standard	Lecture, Activity	AU1761.1	
10	Implementing ISO/IEC 17025	Apply ISO/IEC 17025 standard to calibration processes	Flipped Class, Group Discussion	AU1761.1 AU1761.3 AU1761.4	
11	Calibration certificate and its contents	Understand and create calibration certificate as per international standards	Lecture, Activity	AU1761.2 AU1761.4	
12	Product and process audit	Explain the importance and procedure of product and process audit	Lecture, Activity	AU1761.2 AU1761.4	
13	Standards room parameters and requirements	Understand and analyse various requirements of standards room and the relevant parameters	Flipped Class, Group Discussion	AU1761.2	MTE-II, ETE, Assignments
14, 15	Dimension validation and testing methods for product; Layout inspection methodology for dimension validation	Analyse and apply layout inspection method	Lecture	AU1761.2 AU1761.4	
16, 17	Customer quality management-monitoring final product quality,	Understand the monitoring and audit activities for ensuring customer quality for final product	Lecture	AU1761.2 AU1761.4	

	Product audit, Dock audit, Layout audit				
18	Pre delivery inspection	Prepare Pre delivery inspection checksheet and conduct PDI for given product	Group Discussion	AU1761.2 AU1761.4	
19	Information flow system at customer's end, Improving quality standards of final product	Understand the information flows at customer's end for improving quality system	Lecture	AU1761.2 AU1761.3	
20, 21	Failure testing, testing equipment operational knowledge, Failure testing done for validation	Explain various testing equipments for failure testing with their working knowledge	Lecture, Flipped class	AU1761.2 AU1761.3	ETE, Assignments
22	Tests performed for product and process parameters maintenance	Understand the tests required for maintenance of product and process parameters	Lecture	AU1761.2 AU1761.3	
23	Inspection checkpoints for NPD and production	Analyse various checkpoints during new product development process for ensuring quality of outgoing product	Lecture	AU1761.2	
24	Quality function deployment	Understand and Apply QFD method for converting voice of customer into the technical parameters of the product	Lecture, Activity	AU1761.3 AU1761.4	
25	Conclusion and Course Summarization	Recall and review the manufacturing quality concepts	NA	AU1761.1 AU1761.2 AU1761.3 AU1761.4	NA

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

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
AU 1761.1	Understand the ISO standards defining the requirements pertaining to testing and calibration.	2	0	0	0	0	0	0	0	0	0	0	0	0	3	0
AU 1761.2	Develop skills to conduct audits for inspection of processes and products to monitor process and product quality.	2	2	0	0	0	0	0	2	2	0	1	0	0	3	0
AU 1761.3	Understand the methods for improving final product quality using FMEA, QFD, etc.	3	3	3	1	2	0	0	0	0	0	0	0	0	3	1
AU 1761.4	Implement the quality management measures in automotive industry applications.	3	3	2	0	1	0	0	0	2	0	2	0	0	3	2

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering
Department of Automobile Engineering
Course Hand-out
Computational Fluid Dynamics | AU-1762 | 4 Credits | 3 0 2 4
Session: Jul.19 – Nov.19 | Faculty: Dr. Ashish Malik | Class: VII sem. Dept.Elect.

A. **Introduction:** This course is offered as a department elective course to the students of III Year B Tech Automobile Engineering opting R&D vertical. This course offers detailed knowledge at introductory level including various fundamental equations governing the fluid flow and their conservative / non-conservative formulations. The course will cover existing discretisation methods and numerical techniques widely used for solution of equations. Different solution algorithms, time marching and space marching, explicit and implicit methods will be covered. Students are expected to have background knowledge on Engineering Mathematics, Numerical Methods, Heat Transfer and Fluid Dynamics and be familiar with any programming language (C, Fortran) for better learning.

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

[1762.1] Understand fundamental concepts, identify types of equations and boundary conditions to be used for a particular problem.
[1762.2] Able to discretise a PDE into algebraic equations using different strategies.
[1762.3] Develop solution strategies for discretised equations
[1762.4] Develop own codes and understand theoretical background of commercial codes, thereby enhancing student's employability skills.
[1762.5] Conduct CFD to test the flow of fuel, lubricants, oil and water in the vehicle piping system.
[1762.6] Can pursue advanced CFD courses

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

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

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

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

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

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

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

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

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

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

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

[PSO.1]. **Autotronics and Electric Vehicle Technology:** Apply knowledge of electrical and electronics engineering for providing automobile engineering solutions

[PSO.2]. **Alignment to Super Qualification packs of ASDC:** Demonstrate knowledge and performance criteria as defined by ASDC super qualification packs for R&D or Quality or Service Engineering

[PSO.3]. **Application of Lean Six Sigma Methodology:** Demonstrate through an internship project, the knowledge and understanding of lean six sigma methodology based on Define, Measure, analyse, improve/develop and control/validate phases (DMAIC/ DMADV).

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 (Accumulated and Averaged)	10
	Practical performance (internal)	15
	Practical Assessment	5
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 CFD: Objectives of the course, motivation, and course plan, evaluation method, references, application of CFD in automobile engineering.

Governing Equations and boundary conditions: Introduction to models of flow, conservation laws of physics, derivations of Continuity, Momentum and Energy equations in Cartesian coordinate system, Transformation of these equations from Non conservative form to conservative; Implementation of boundary conditions- Inlet, outlet, wall boundary conditions

Numerics:- Discretization Process- concept and structure, , Explicit Taylor series expansion, Methods of deriving the discretized equations, Finite Difference, Finite Volume methods. Stability criteria, errors in calculations, Mathematical behaviour of PDEs, Structured grid, staggered grid, Mesh less techniques.

Solution algorithms: One-way and two-way co-ordinates, The Four basic rules in control volume formulation. Staggered Grid, Pressure corrections as Poisson's Pressure equation, QUICK, SIMPLE, PISO algorithms, TDMA, Point Iterative Methods, Explicit methods- Crank Nicolson, Implicit methods,

Result Visualization: - Usage of plotting software (open source, commercial), contour plots, velocity vectors, heat maps, etc.

F. Text Book:

- H K Verseteeg and W Malalasekra, *An Introduction to Computational Fluid Dynamics- Finite Volume Method*, Second Edition, Pearson, England, 2007

G. References:

- K.Muralidhar and T.Sundararajan, *Computational Fluid Flow and Heat Transfer*, Narosa Publishing House, New Delhi, 2003.

- D.A. Anderson, J.C. Tannehill, and R.H. Pletcher, *Computational Fluid Mechanics and Heat Transfer*, Taylor and Francis Group, New York, 1997.

- J.D. Anderson Jr., *Computational Fluid Dynamics- The Basics with Applications*, International Edition, McGraw Hill, New York., 1995

H. Lecture Plan:

Lecture No.	Topics	Session Outcomes	Mode of Delivery	Course outcome	Mode of Assessing the Outcome
1	**Introduction**	To acquaint and clear teachers expectations and understand student expectations	Lecture		N/A
2	CFD applications in automobile engineering	Explain the applications of CFD in vehicle design, software commercial & open source	Lecture Flipped Class room	[AU 1762.1]	Class Quiz Mid term End term
3,	**Governing Equations:** Continuity	Introduction to governing laws of physics: Derivation of continuity	Lecture	[AU 1762.1]	Class Quiz Mid term End term
4,5	Flow in a Lid-driven cavity	Setup and solution of the 2D laminar fluid flow for a lid driven cavity.	CFD LAB session	[AU 1762.1]	Hand On practical
6	Momentum Equation	Derivation of Energy Eqn.	Lecture	[AU 1762.6]	Home Assignment Mid term End term
7	Energy Equation	Transformation of governing eqns from Non conservative form to conservative;	Lecture	[AU 1762.1]	Home Assignment Class Quiz Mid term End term
8	Transformation of Equations	Implementation of boundary conditions- Inlet, outlet, wall boundary conditions	Lecture	[AU 1762.2]	Class Quiz Mid term End term
9,10	Flow in an Intake Manifold	Modelling turbulent flow in a simple intake manifold geometry.	CFD LAB session	[AU 1762.2]	Hand On practical
11	Classification of Equations & their behaviour	Understanding the Concepts of Discretization Process- concept and structure,	Lecture Flipped Classroom	[AU 1762.6]	Home Assignment Class Quiz Mid term End term
12	Classification of Equations & their behaviour	Methods of deriving discretised equations	Lecture	[AU 1762.2]	Home Assignment Class Quiz Mid term End term
13	Boundary conditions	Understanding & Deriving Finite Difference formulation Understanding & Deriving Finite Difference formulation	Lecture	[AU 1762.2]	Class Quiz Mid term End term
14, 15	Flow and Heat Transfer over a Flat Plate	Setup and solution of the 2D laminar fluid flow over a flat plate	CFD LAB session	[AU 1762.2]	Hand On practical
16	**Numeric:-** Introduction to Discretization Process- concept and structure,	Stability criteria, and estimation of errors in numerical calculations	Lecture Flipped Classroom	[AU 1762.2]	Home Assignment Class Quiz Mid term End term
17	Taylor Series Expansion	Mathematical behaviour of PDEs and impact on CFD	Lecture	[AU 1762.6]	Home Assignment Class Quiz Mid term End term

18	Finite Difference Methods	Understanding Structured and Unstructured grids used for calculations.	Lecture	[AU 1762.3]	Class Quiz Mid term End term
19,20	Simulation of Flow Development in a Pipe	Setup and solution of a 3D turbulent fluid flow in a pipe.	CFD LAB session	[AU 1762.3]	Hand On practical
21	Finite Volume method	Solution of discretised equations by marching in space and time	Lecture	[AU 1762.3]	Class Quiz Mid term End term
22	Finite Volume method	Solution of discretised equations by marching in space	Lecture	[AU 1762.3]	Home Assignment Class Quiz Mid term End term
23	1-D steady State Diffusion Problems	Understanding the usage of Iterative schemes, ADI, TDMA schemes,	Lecture	[AU 1762.3]	Home Assignment Class Quiz Mid term End term
24, 25	Modelling Compressible Flow over an Airfoil	Setup and solution of an external compressible flow	CFD LAB session	[AU 1762.6]	Hand On practical
26	Boundary Condition Implementation, Unsteady Problems	Understanding the usage of boundary condition in solutions of PDEs	Lecture	[AU 1762.4]	Home Assignment Class Quiz End term
27	Numerical Stability issues in Unsteady Problems	Understanding the usage of Explicit and Implicit schemes	Lecture	[AU 1762.4]	Home Assignment Class Quiz End term
28	Types of Grids	Contour Plots, Stream Lines, Maps, Fluid Flow visualisation	Lecture	[AU 1762.5]	Home Assignment Class Quiz End term
29, 30	Flow Past a Circular Cylinder	setup and solution of an unsteady flow past a circular cylinder and study vortex shedding process	CFD LAB session	[AU 1762.5]	Hand On practical
31	**Solution Algorithms:** Space marching (1 way & 2 way coordinates)	Understanding the usage of different upwind schemes	Lecture,	[AU 1762.5]	Home Assignment Class Quiz End term
32	Time Marching Time advancements	Understanding the time marching concept for parabolic equations	Lecture,	[AU 1762.5]	Home Assignment Class Quiz End term
33	Upwind Schemes	QUICK, SIMPLE, PISO	Lecture,	[AU 1762.6]	Class Quiz Mid term End term
34, 35	Inviscid and Compressible Flow through a Converging-Diverging Nozzle	setup and solution of an axisymmetric fluid flow through a nozzle.	CFD LAB session		Hand On practical
36,37	Pressure Velocity coupling	QUICK, SIMPLE, PISO	Lecture	[AU 1762.6]	Class Quiz Mid term End term
38	CFD Codes in Fortran	open-source CFD codes	Lecture		
39, 40	Modeling Turbulent Flow in a Mixing Tank	setup and solution of a 3D turbulent fluid flow for periodic section of a mixing tank	CFD LAB session		Hand On practical
41,	CFD Libraries	LAPACK Subroutines,	flipped classroom	[AU 1762.5]	
42	CFD Codes in C	Open Source CFD codes in C	Lecture		
43	Code compilation	Use of Intel Compilers	flipped classroom		

44,45	CFD Code in Fortran	Running a CFD in Fortran language	CFD LAB session		Hand On practical
47	Result Visualisation	Contour Plots, Stream Lines,	Lecture		
48	Result Visualisation	Iso-surface Maps, Fluid Flow visualisation	Lecture	[AU 1762.6]	
49,50	CFD Code in Fortran	Running a CFD in Fortran language	CFD LAB session		Hand On practical
51	Doubt Session	Question & answers / doubts			

I. Course articulation matrix: -

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
AU 1762.1	Understand fundamental concepts, identify types of equations and boundary conditions to be used for a particular problem.	3	2						1	1				2	1	
AU 1762.2	Able to discretise a PDE into algebraic equations using different strategies.		2	2	2					2				2	1	
AU 1762.3	Develop solution strategies for discretised equations		2		2					2				2	1	
AU 1762.4	Develop own codes and understand theoretical background of commercial codes, thereby enhancing student's employability skills.	2	2						1	2				2	1	
AU 1762.5	Conduct CFD to test the flow of fuel, lubricants, oil and water in the vehicle piping system.	2	2						1	2				2	1	
AU 1762.6	Can pursue advanced CFD courses		2	3	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 Automobile Engineering
Course Hand-out

Autotronics and Automotive safety system | AU 1763 | 3 Credits | 3 0 2 3

Session: July19 to Dec 19 | Faculty: Upendra Kulshrestha | Class: 4th Yr/7th sem

A. Introduction: This course is offered for students of Automobile Engineering final year, as program elective course that helps students who wish to pursue their career in sales & service automotive as well as Vehicle electronics and its safety systems final year. In Morden automobile engineering maximum systems ia associated with electric devices which is most mostly rekated to vehicle safety systems like, Airbags, ABS, ESP, Seat belt etc. Autotronics is the backbone of current automobile every system of vehicle is directly and indirectly related to autotronic like , electronic fuel system (CRDI & MPFI).

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

AU 1763.1 : Understanding the concept of vehicle safety system

AU 1763.2 : Knowledge of vehicle comfort and convenient system

AU 1763.3 : Familiar with advance electronic train control.

AU 1763.4 : **Enhancement of employment and entrepreneurship skill through hands on practice on different** concept of various faults in vehicle safety and electronic control

C. Program Outcomes and Program Specific Outcomes:

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

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

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

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

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

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

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

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

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

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

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

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

[PSO.1]. Autotronics and Electric Vehicle Technology: Apply knowledge of electrical and electronics engineering for providing automobile engineering solutions

[PSO.2]. Alignment to Super Qualification packs of ASDC: Demonstrate knowledge and performance criteria as defined by ASDC super qualification packs for R&D or Quality or Service Engineering

[PSO.3]. Application of Lean Six Sigma Methodology: Demonstrate through an internship project, the knowledge and understanding of lean six sigma methodology based on Define, Measure, analyse, improve/develop and control/validate phases (DMAIC/ DMADV).

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)	10
	In semester practical components	12
End Term Exam (Summative)	End Term Exam (Open Book)	40
	End Semester Practical Components	8
	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. This 75% is required individually in both theory and practical component. The Student will be detained if he / she fails to achieve 75% in any one or both.	
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:

AUTOMOTIVE SAFETY AND SECURITY SYSTEMS: Seat belt, automatic seat belt lightener system, Anti-theft systems, Automatic door locks (ADL), Electronic active and passive safety, Antilock braking system, air bags, electronic system for activating air bags, supplementary restraint systems (SRS), Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system interactions, Electronic chassis control system. **COMFORT AND CONVENIENCE SYSTEM:** Steering and mirror adjustment, central locking system, tire pressure monitoring system, rain sensor system, environment information system, Head up display, Driver information systems, On board navigation system, Electronic climate control, Electronic cruise control, electronically controlled sunroof, Electronically controlled headlight systems, Electronically controlled mirrors. **ADVANCED ELECTRONIC POWERTRAIN CONTROL:** Gasoline direct injection, Electronic Diesel Control, Unit Injector System, Common Rail System, Data processing, Fuel-injection control, Electronic transmission control, Special adaptations for Internal and external modification using digital computer management system, utilizing electronic circuit design and reprogramming.

FAULT DIAGNOSIS: OBD II, On-board diagnosis, Organic light emitting displays for diagnosis, anti-lock braking system/air bag scan tools, automotive scanners, graphing scanners, different diagnosis tools, Testing equipments, Test benches, Diagnosis in the workshop.

Text Book:

1. Robert Bosch Gmbh, "*BOSCH: Automotive Electrics and Automotive Electronics*", 5th edition, Springer 2007

References:

1. William B. Ribbens, "*Understanding Automotive Electronics*", Seventh Edition, Elsevier, 2012.
2. K. Reif, "*BOSCH: Diesel Engine Management*", John Wiley & Sons, 2003.
3. Ljubo Vlacic, Michel Parent and Fumio Harashima, "*Intelligent Vehicle Technologies*", First Edition, Butterworth Heinemann, 2001

F. Lecture Plan:

Lec No.	Topics	Session Objective	Mode of delivery	Corresponding CO	Mode of assessing the outcome
1	Introduction and course out briefing	To acquaint and clear teacher expectation and understand and understand students expectation	lecture	AU1763.1	NA
2	Overview of passive and active safety device in vehicle	To understating of basic knowledge and types of passive and active devices	lecture	AU1763.1	Quiz

3	Seat belt, automatic seat belt lighting system	Basics of seat belt principle and its working	lecture	AU1763.1	Quiz
4	Anti-theft systems, automatic door locking	Importance of ATS and its working layout	lecture	AU1763.1	Quiz
5	Ant locking braking system(ABS), Air bag	Importance of ABS as comparison of ordinary braking system, working principle of air bag	lecture	AU1763.1	Quiz
6	Electronics system for activating air bags	Understanding of basic activation process of air bag	lecture	AU1763.1	Quiz
7	Supplementary restraint systems (SRS)	Application of SRS	lecture	AU1763.1	Home assignment
8	Collision warning system, causes of rear end collision	Importance of collision repairing system	lecture	AU1763.1	Quiz
9	frontal object detection, rear vehicle object detection system	Front and rear object detection system working and principle	lecture	AU1763.1	Home assignment
10	Object detection system with braking system interactions	Knowledge of braking system interactions through object detection	lecture	AU1763.1	Quiz
11	Electronic chassis control system	Understanding of electronic chassis control in Morden vehicle	lecture	AU1763.1	Quiz
12	Comfort and convenience system	Working of convenience system	lecture	AU1763.2	
13	Steering and mirror adjustment	Importance of steering and mirror adjustment system.	lecture	AU1763.2	Home assignment
14	central locking system	Importance of central clocking system as comparison of ordinary locking system	lecture	AU1763.2	Quiz

15	Students Presentation based on allotted topics	Students presentation	Presentation	NA	Quiz
16	Students Presentation based on allotted topics	Students presentation	Presentation	NA	Quiz
17	Students Presentation based on allotted topics	Students presentation	Presentation	NA	Quiz
18	environment information system, rain sensor system	Working principle of rain sensor ,environment information system	lecture	AU1763.2	Home assignment
19	Driver information systems, On board navigation system	Importance of Driver information system and on board navigation system	lecture	AU1763.2	
20	Quiz-I	Quiz-I	Quiz		Quiz
21	electronically controlled sunroof	Working of electronic control sunroof	lecture	AU1763.2	
22	Electronically controlled headlight systems, Head up display	Application of head up display	lecture	AU1763.2	Home assignment
23	Electronically controlled mirrors	Working of electronic control mirror	lecture	AU1763.2	Quiz
24	Introduction of advanced electronic powertrain control	Knowledge of electronic powertrain control	lecture	AU1763.3	Quiz
25	Gasoline direct injection	Working and layout of GDI system	lecture	AU1763.3	Home assignment
26	Electronic Diesel Control	Knowledge of electronic diesel control system	lecture	AU1763.3	Quiz
27	Unit Injector System	Application and working of unit injector system of vehicle	lecture	AU1763.3	Home assignment
28	Common Rail System, Data processing	Working and advantage of CRDI system	lecture	AU1763.3	Home assignment

29	Fuel-injection control	Working principle of fuel injection control	lecture	AU1763.3	Quiz
30	Electronic transmission control	Working anf trouble shooting of ETC	lecture	AU1763.3	
32	Assignment	Assignment based on above chapters	assignment		
33	Quiz -2	Subject knowledge evaluation through quiz	Quiz		
34	Tire pressure monitoring system	Knowledge of basic concept and parts of TPMS	lecture	AU1763.3	Home assignment
35	Electronic climate control, Electronic cruise control	Understanding of working of ECC	lecture	AU1763.3	Quiz
36	Special adaptations for Internal and external modification using digital computer management system	Knowledge of Computer management system of vehicle	lecture	AU1763.3	
37	Electronic transmission control	Application of ETC	lecture	AU1763.3	Home assignment
38	Special adaptations for Internal and external modification using digital computer management system	Adaptations of ETC through Computer management system	lecture	AU1763.3	
39	utilizing electronic circuit design and reprogramming	Familiar with electronic circuit design and reprogramming	lecture	AU1763.3	Quiz

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
[1763.1]	Understanding the concept of vehicle safety system	3							1							
[1763.2]	Knowledge of vehicle comfort and convenient system		2	2								2				
[1763.3]	Familiar with advance electronic train control.				2	2										
[1763.4]	**Enhancement of employment and entrepreneurship skill through hands on practice on different** concept of various faults in vehicle safety and electronic control						2		2	3						

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Automobile Engineering
Course Hand-out

Supplier Quality Management | AU 1764| 3 Credits | 3 0 2 4

Session: Jul 19 – Nov 19 | Faculty: Dr. Vinod Yadav and Dr. Avanish Singh Chauhan | Class: VII Semester (Program Elective)

A. Introduction: This course is offered by Dept. of Automobile Engineering for seventh semester students as department elective course. This course provides knowledge of steps and procedures to be followed in order to ensure supplier's ability to deliver a good or service that will satisfy the customer's needs. Any company that relies on suppliers and vendors to provide services or products must also bear the responsibility for managing their supply chains adequately. Meticulous supplier quality management is particularly essential for regulated companies Students are expected to have information about ISO 9001 and in particular knowledge about IATF16949 standards followed in an automotive sector to ensure quality.

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

[1764.1] Gain knowledge about supplier environment, cost structure, departments and various parameters affecting the supplier environment.

[1764.2] Understand the process of supplier audits and analyse how to document the relationship between different companies in order to verify compliance of a supplier's products and processes.

[1764.3] Develop a corrective action plan and collaboration plan to minimize shortages and keep costs down.

[1764.4] Acquire knowledge/ skills about electronic supplier quality management system (QMS) is critical to success.

[1764.5] Evaluate, assess and manage performance of suppliers, supplier performance metrics, and measurement process techniques.

C. Program Outcomes and Program Specific Outcomes

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

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

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

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

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

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

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

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

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

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

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

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

[PSO.1]. **Autotronics and Electric Vehicle Technology:** Apply_knowledge of electrical and electronics engineering for providing automobile engineering solutions

[PSO.2]. **Alignment to Super Qualification packs of ASDC:** Demonstrate knowledge and performance criteria as defined by ASDC super qualification packs for R&D or Quality or Service Engineering

[PSO.3]. **Application of Lean Six Sigma Methodology:** Demonstrate through an internship project, the knowledge and understanding of lean six sigma methodology based on Define, Measure, analyse, improve/develop and control/validate phases (DMAIC/ DMADV).

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
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

SUPPLIER QUALITY MANAGEMENT: Monitor quality of incoming materials: Supplier Environment, capacity, capability, cost structures, delivery time, and reliability factors. Packaging and transportation methods for each part and sub-assembly Incoming inspection checkpoints, dimension validation and performance testing methods. Production Part Approval Process (PPAP); requirements, documentation. Information systems such as SAP, ERP etc., P.O.s raised in SAP, **Inspect and maintain product quality and implement corrective action:** supplier audit methodology, checklist for supplier audit, composite score calculation technique, method of updating supplier ratings in SAP, suppliers' organization details retrieval methods from SAP, information flow for updating supplier's records **Collaborate with suppliers for cost reduction and process improvement:** Corrective and Preventive Action (CAPA) implementation procedure and methodology, Supplier

Corrective Action (SCAR) reporting format). Evaluate and manage performance of suppliers, supplier performance metrics, and measurement process techniques such as supplier scorecard/MIS/KPIs, supplier contract terms, customs/import/other duties levied for overseas suppliers, charge back rates, product unit cost calculation systems followed by sourcing team
Lab: Develop a Supplier Audit plan and calculate composite score to identify CAPAs for improving Supplier performance. Develop a Part Approval Process (PPAP) report.

F. Text Books

T1. Mark Allen Durivage, *The Certified Supplier Quality Professional Handbook*, American Society for Quality, ASQ Quality Press, 2017.

G. Reference Books

R1. Frank Gryna, Richard Chua, Joseph Defeo, Juran's *Quality Planning and Analysis*, McGraw Hill Education, 5th edition (20 June 2006).

H. Lecture Plan:

Lecture No.	Topics	Session Objective	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction and Course Hand-out briefing	To acquaint and clear teachers expectations and understand student expectations	Lecture	NA	NA
2	Introduction to Supplier Environment.	Define and introduce various domains of a supplier quality management system.	Lecture	[AU1764.1]	In Class Quiz (Not Accounted)
3,4	Monitor quality of incoming materials: supplier capacity, supplier capability	Develop an understanding of assessing supplier capacity, supplier capability.	Lecture	[AU1764.1]	In Class Quiz (Not Accounted)
5,6	Monitor Supplier quality: cost structure, delivery time, reliability factors.	Identify different cost structures followed in a supplier management system, estimating the delivery time, analysing the reliability of incoming material.	Lecture	[AU1764.1]	Class Quiz, Activity
7, 8	Packaging and transportation methods	Understand different packaging and transportation methods for part and sub-assembly movement.	Lecture	[AU1764.1] [AU1764.5]	Activity
9, 10	Incoming inspection checkpoints		Lecture, activity	[AU1764.1] [AU1764.2]	Class Quiz
11-13	Dimension validation and performance testing methods		Lecture	[AU1764.1] [AU1764.2]	Class Quiz
14,15	Production Part Approval process (PAPP)	Understand the requirements and documentation involved in a PPAP process	Expert Lecture, Activity	[AU1764.1] [AU1764.2] [AU1764.5]	Class Quiz
16-20	Introduction to SAP and ERP	Introduction to online management tools such as SAP and ERP, how P.O. is raised in SAP, method of updating supplier ratings in SAP, suppliers' organization details retrieval methods from SAP	Lecture, Activity	[AU1764.1] [AU1764.2] [AU1764.4]	Class Quiz
21-24	Introduction to Supplier audit methodology	Develop an understanding of how to perform supplier audit, learn about supplier audit checklist, understand composite score calculation technique	Expert Lecture, activity	[AU1764.1] [AU1764.2]	Class Quiz, Activity

		and information flow for updating supplier's records			
25-27	Corrective and Preventive Action (CAPA)	Understand the CAPA implementation procedure and methodology	Lecture, activity	[AU1764.1] [AU1764.2] [AU1764.3]	Class Quiz
28-30	Supplier Corrective Action (SCAR)	Learn how to develop a SCAR report	Expert Lecture, activity	[AU1764.1] [AU1764.2] [AU1764.3]	Class Quiz, Activity
31-33	Supplier Performance Evaluation Metrics	Understand how to evaluate and manage performance of suppliers, supplier performance metrics.	Lecture, Activity	[AU1764.1] [AU1764.2] [AU1764.5]	Class Quiz, Activity
34-36	Supplier Performance Measurement	Learn about various supplier performance measurement process techniques such as supplier scorecard/MIS/KPIs	Lecture, activity	[AU1764.1] [AU1764.2] [AU1764.5]	Class Quiz, Activity
37-38	Supplier contract terms	Learn about the formulation and criterion to be kept in consideration during formulation of supplier contract.	Lecture	[AU1764.1] [AU1764.2] [AU1764.3] [AU1764.5]	Class Quiz
39-42	Supplier cost	Learn about various customs/import/other duties levied for overseas suppliers charge back rates, product unit cost calculation systems followed by sourcing team	Lecture, activity	[AU1764.1] [AU1764.2] [AU1764.3]	Class Quiz, Activity
43-47	Supplier Audit plan	Develop a Supplier Audit plan and calculate composite score to identify CAPAs for improving Supplier performance	Lab, activity	[AU1764.1] [AU1764.2] [AU1764.3] [AU1764.4]	Class Quiz, Activity
48-52	PPAP report	Learn how to develop a PPAP report.	Lab, activity	[AU1764.1] [AU1764.2] [AU1764.3] [AU1764.4]	Class Quiz, Activity

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
AU 1764.1	Gain knowledge about supplier environment, cost structure, departments and various parameters affecting the supplier environment.	2	0	2	1	1	3	3	1	2	1	2	1	0	3	1
AU 1764.2	Understand the process of supplier audits and analyse how to document the relationship between different companies in order to verify compliance of a supplier's products and processes.	1	3	2	3	3	3	3	2	3	2	1	1	0	3	1
AU 1764.3	Develop a corrective action plan and collaboration plan to minimize shortages and keep costs down.	2	3	3	3	3	0	1	1	2	3	3	2	0	3	1
AU 1764.4	Acquire knowledge about electronic supplier quality management system (QMS) is critical to success.	0	2	3	2	3	0	3	0	2	3	2	1	0	3	1
AU 1764.5	Evaluate, assess and manage performance of suppliers, supplier performance metrics, and measurement process techniques.	0	3	2	1	2	2	0	0	3	2	3	1	0	3	1

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Automobile Engineering
Course Hand-out

Vehicle Ergonomics and Styling| AU 1765 | 3 Credits | 3 0 0 3

Session: Jul 19 – Nov 19 | Faculty: Dharmesh Yadav | Class: Department Elective

A. Introduction: This course is offered by Dept. of Automobile Engineering as a Department Elective, targeting students who wish to pursue Sales and Service in industries or higher studies in field of Automotive Engineering. Offers in depth knowledge of Ergonomics theory by covering Anthropometry, percentile curves, Positioning of operational controls, Human Factors, Vehicle Packaging and Manikin. Students are expected to have background knowledge on vehicle technology for a better learning.

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

[1765.1]. Describe the effects of Ergonomics and depict Vehicle Packaging, its effect on vehicle design and styling.

[1765.2]. Interpret and illustrate the styling process based on different operating and design parameters and car proportions.

[1765.3]. Experiment with different Anthropometric data, percentile curves, calculate car proportions and modify different Positioning of operational controls to control styling process.

[1765.4]. Recognize different styling process and judge the best way to achieve Vehicle Packaging for a specific vehicle.

[1765.5]. Recall different ergonomic procedures for different types of vehicles, chose Anthropometric data in an automobile for Vehicle Packaging.

[1765.6]. Fabricate Clay Modelling, Logical formation of cockpit, and measure its performance by Loading/Unloading 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

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

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

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

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

[PSO.1]. **Autotronics and Electric Vehicle Technology:** Apply_knowledge of electrical and electronics engineering for providing automobile engineering solutions

[PSO.2]. **Alignment to Super Qualification packs of ASDC:** Demonstrate knowledge and performance criteria as defined by ASDC super qualification packs for R&D or Quality or Service Engineering

[PSO.3]. **Application of Lean Six Sigma Methodology:** Demonstrate through an internship project, the knowledge and understanding of lean six sigma methodology based on Define, Measure, analyse, improve/develop and control/validate phases (DMAIC/ DMADV).

D. Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Open Book)	20
	Sessional Exam II (Open Book)	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	10
End Term Exam (Summative)	End Term Exam (Open Book)	50
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, 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 styling Car Design, Fundamentals of perspective drawing, Automotive Sketching, Styling process, Car proportions, Aerodynamics, Crashworthiness and its influence on body design, Designing of Interiors Form studies **Form studies**, Speed Forms, Clay Modeling, 2D systems, 3D systems **Fundamentals of Ergonomics** Dimension Determination, Anthropometry – Need, Data collection methodology, Different postural considerations, Measuring Procedures Subject and Sampling size selection, Measurement of Hands/Feet/Full posture, Applying Anthropometry data, Application of percentile curves **Vehicle Ergonomics** Passenger Compartment, Floor Pan, Technical requirements, Dash board equipment's arrangement, Positioning of operational controls, Force Analysis, Seating and position(ECE Regulations),s Human Factors, Navigation systems,

pedal positioning **Vehicle Packaging** R-Point, AHP, Manikin positioning of 2-D pattern, car entry/exit, Sight – All round visibility, View of Instruments, Mirror design, Logical formation of cockpit, Boot lid packaging, Loading/Unloading analysi.

F. Text Books

1. Vivek D Bhise, "Ergonomics in the Automotive Design Process", 2013, ISBN- 10:1439842108

G. Reference Books

1. Tony Lewin, "How to Draw Cars like a Pro", Motorbooks International, 2003
2. Thom Taylor, Lisa Hallett, "How to Draw Cars like a Pro", Motorbooks International; 2Rev Ed edition, 2006
3. Julian Happian-Smith, "An introduction to modern vehicle design", Butterworth Heinmenn, 2001
4. Fenton John, "Handbook of automotive body and system design", Wiley-Blackwell, 1998
5. J. Brian Peacock, Waldemar Karwowski, "Automotive ergonomics", Taylor & Francis ltd, 1993

H. Lecture Plan:

Lect. No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction to styling	Recall vehicle dimensions and types of vehicle bodies and styling	Flipped Classroom	1765.1	In Class Quiz (Not Accounted)
2	Car Design	Identify different car designs and layouts	Lecture	1765.2	In Class Quiz
3	Fundamentals of perspective drawing	Explain fundamentals of perspective drawing and its effects	Lecture	1765.2	Home Assignment
4	Fundamentals of perspective drawing	Explain fundamentals of perspective drawing and its effects	Lecture	1765.2	In Class Quiz
5	Automotive Sketching	Describe Automotive Sketching and its applications	Activity (Jigsaw)	1765.1	Class Quiz
6	Styling process	Recognize process, sequence of development and design	Flipped Class	1765.4	Home Assignment Class Quiz
7	Styling process	Illustrate and describe sequence of development and styling process	Activity (Think Pair Share)	1765.4	Class Quiz
8	Car proportions	Analyse the role of proportion in finding a pleasing balance and 'feel'	Lecture	1765.2	Class Quiz
9	Aerodynamics	Identify role of Aerodynamics in styling	Jigsaw	1765.6	Class Quiz
10	Crashworthiness and its influence on body design	Explain the importance of crashworthiness in designing process	Lecture, Activity	1765.2	Class Quiz
11	Designing of Interiors	Explore concepts of interior designing	Lecture, Activity	1765.2	Class Quiz
12	Form studies	Examine the scope of improvements in design through form studies	Lecture	1765.2	Class Quiz
13	Speed Forms	Examine the scope of improvements in design through speed forms	Lecture, Activity	1765.2	Class Quiz
14	Clay Modelling	Recognize various clay modelling methods and	Lecture	1765.2	Class Quiz

		investigate its role in styling			
15	2D systems	Identify different systems used and sketch 2D models using software	Lecture, Activity	1765.1	Home Assignment
16	3D systems	Identify different systems used and sketch 3D models using software	Lecture, Activity	1765.1	Class Quiz
17	Fundamentals of Ergonomics	Express understanding of ergonomics used in	Lecture	1765.1	Class Quiz
18	Dimension Determination	Discover the various dimensions related to vehicle design	Lecture	1765.3	Class Quiz
19	Anthropometry	Define and understand the Anthropometric data and its need	Lecture, Activity	1765.1	Class Quiz
20	Anthropometry – Need	Define and understand the Anthropometric data and its need	Lecture, Activity	1765.1	Class Quiz
21	Data collection methodology	Explore and choose appropriate data for designing	Lecture	1765.3	Class Quiz
22	Different postural considerations	Recognise and summarize different postural considerations	Lecture	1765.3	Class Quiz
23	Measuring Procedures	Discover various measuring procedures	Lecture	1765.3	Class Quiz
24	Subject and Sampling size selection	Categorize subject and sampling size selection	Lecture, Activity	1765.3	Class Quiz
25	Measurement of Hands/Feet	Confirm relevant Measurement of Hands/Feet	Lecture	1765.1	Class Quiz
26	Measurement of /Full posture	Confirm relevant Measurement of full posture	Lecture	1765.1	Class Quiz
27	Applying Anthropometry data	Applying Anthropometry data	Lecture	1765.3	Class Quiz
28	Application of percentile curves	Interpret the application of percentile curves	Lecture	1765.3	Class Quiz
29	Vehicle Ergonomics	Identify the importance of vehicle ergonomics in designing	Lecture, Activity	1765.1	Class Quiz
30	Passenger Compartment, Floor Pan & Technical requirements	Summarize Passenger Compartment, Floor Pan & Technical requirements	Lecture	1765.3	Class Quiz
31	Dash board equipment's arrangement	Relate and match Dash board equipment's arrangement	Lecture, Activity	1765.4	Class Quiz
32	Positioning of operational controls	Discover the Positioning of operational controls	Lecture, Activity	1765.3	Class Quiz
33	Force Analysis, Seating and position(ECE Regulations)	Confirm the Force Analysis, Seating and position(ECE Regulations)	Lecture	1765.6	Class Quiz
34	Human Factors, Navigation systems	Recognize the Human Factors and Navigation systems	Lecture, Activity	1765.2	Class Quiz

35	pedal positioning,	Locate pedal positioning	Lecture, Activity	1765.3	Class Quiz
36	Vehicle Packaging	Compare Vehicle Packaging	Lecture, Activity	1765.1	Class Quiz
37	R-Point, AHP, Manikin positioning of 2-D pattern,	Recognize R-Point, AHP, Manikin positioning of 2-D pattern,	Lecture, Activity	1765.1	Class Quiz
38	car entry/exit, Sight – All round visibility,	Recognize car entry/exit, Sight – All round visibility,	Lecture, Activity	1765.1	Class Quiz
39	View of Instruments, Mirror design,	Compare View of Instruments, and match Mirror design,	Lecture	1765.5	Class Quiz
40	Logical formation of cockpit,	Choose logical formation of cockpit	Lecture, Activity	1765.5	Class Quiz
41,42	Boot lid packaging, Loading/Unloading analysis	Discover Boot lid packaging, Loading/Unloading analysis	Lecture, Activity	1765.6	Class 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
AU 1765.1	Describe the effects of Ergonomics and depict Vehicle Packaging, its effect on vehicle design and styling.	**3**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**2**			
AU 1765.2	Interpret and illustrate the styling process based on different operating and design parameters and car proportions.	**1**	**2**	**0**	**1**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**2**			
AU 1765.3	Experiment with different Anthropometric data, percentile curves, calculate car proportions and modify different Positioning of operational controls to control styling process.	**2**	**1**	**0**	**1**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**1**			
AU 1765.4	Recognize different styling process and judge the best way to achieve Vehicle Packaging for a specific vehicle.	**0**	**0**	**0**	**2**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**3**			
AU 1765.5	Recall different ergonomic procedures for different types of vehicles, chose Anthropometric data in an automobile for Vehicle Packaging.	**1**	**2**	**0**	**1**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**2**			
AU 1765.6	Fabricate Clay Modelling, Logical formation of cockpit, and measure its performance by Loading/Unloading analysis.	**0**	**0**	**0**	**2**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**3**			

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

MANIPAL UNIVERSITY JAIPUR

School of Automobile Mechanical and Mechatronics Engineering

Department of Automobile Engineering
Course Hand-out

Automotive Chassis System | AU 1766 | 3 Credits | 3 0 2 3

Session: July 18 – Dec 18 | Faculty: Upendra Kulshrestha & Satish Namdev | Class: 4th Yr/7th sem

A. Introduction: This course is offered for students of Automobile Engineering final year, as program elective course that helps students who wish to pursue their career in sales & service automotive as well as vehicle service operation management & vehicle diagnosis sector or higher studies in field of Automotive Engineering. Offers introductory level knowledge service operation, since this course taught in final year automobile engineering students so that students should well aware about basics of automobile engineering concept such as automobile sub systems viz. chassis system, suspension system, electrical systems etc. In this course students will know about vehicle service operation management like vehicle warranty, role of service supervisor and service advisor, key parts management etc.

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

[1766.1] Describe concept of vehicle warranty, types and its policies

[1766.2] explain the functioning of vehicle parts inventory system and their management, role of parts manager.

[1766.3] Describe key role and importance of service advisor, estimation and costing, opening and closing of job card, knowledge of body shop working.

[1766.4] Knowledge of documentation in routine services. Access procedure of service bulletin.

[1766.5] Overview of customer feedback system, technical specification of OEM product for service, planning for better service offering to customer.

[1766.6] Explain activity related to service performance, staff skill enhancement, product performance and feedback

C. Program Outcomes and Program Specific Outcomes:

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

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

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

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

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

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

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

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

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

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

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

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

[PSO.1] **Autotronics and Electric Vehicle Technology:** Apply knowledge of electrical and electronics engineering for providing automobile engineering solutions

[PSO.2] **Alignment to Super Qualification packs of ASDC:** Demonstrate knowledge and performance criteria as defined by ASDC super qualification packs for R&D or Quality or Service Engineering

[PSO.3] **Application of Lean Six Sigma Methodology:** Demonstrate through an internship project, the knowledge and understanding of lean six sigma methodology based on Define, Measure, analyse, improve/develop and control/validate phases (DMAIC/ DMADV).

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)	10
	In semester practical components	12
End Term Exam (Summative)	End Term Exam (Open Book)	40
	End Semester Practical Components	8
	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. This 75% is required individually in both theory and practical component. The Student will be detained if he / she fails to achieve 75% in any one or both.	
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:

Warranty Processing: Overview of warranty policies, various types of warranty offered by OEMs, terms and conditions of warranty, benefits and tenure condition of warranty, claim procedure of settlement in warranty condition. Procedure of processing warranty claim through manual and software. Nomenclature and technical specification of parts numbering make and variant under warrant, new warranty policies implementation procedure as per warranty manual issued by manufactures. Communication procedure of warranty requirement of the newly launched vehicle**,** various types of failed parts in warranty room **Spare Parts Management :** Overview of parts supply chain management, measurement of performance of OEM , technical specification of spare parts issued by OEM and competitors, knowledge of child parts, recording of parts numbering system and parts terminology Parts catalogue of newly launched vehicle, Forecasting demand of parts, cost elements while managing inventory, FIFO Method price negotiation of parts, payment cycle and order system, knowledge of tax regulation, manual handling technique of parts without assistance, stock management of parts, , checking incoming parts stock against requirements, New parts location system against new vehicle launch. Overview of parts management for retro fitment. Manage dead and slow moving stocks. Knowledge of profit and loss statement, Delivery of spare parts, damaged parts claim procedure**. Service Advisor :** Estimation of time and cost of materials, customer agreements on job cards and cost estimates, estimation of parts and flat labor rate, closing of job card after completion of work, service contract under warranty condition offered by the dealership. Service bulletin issued by manufacturers. Documents under routine service, body repairs and maintenance. AMC offered by dealership. Access procedure of service bulletin**, Area Technical lead** : Overview of customer feedback system, technical specification of OEM product for service, Planning for better service offering by OEM, Marketing campaign for effective service delivery, sales tool, customer queries about service offering by OEM **Customer Care**: Activities related to service center performance enhancement (Expert training, profitability, value added service), Improvement of service level with in dealership network, Service Parameter: customer engagement Index, service quality, dealer satisfaction index, skill enhancement, customer centric activities. Product performance and feedback. Cost effective services at dealership, **Service office Management:** knowledge of service related reports parameters, monitoring service related training at dealership, Market requirement for OEM product, Market research

Text book:

1. Anil Chikara "Automobile Marketing & workshop techniques" Automobile Engineering Vol-3, Satya publication

References:

1. Rezin , Andrew, *Automotive Service Management- Principle to service*, PHI publication

2. Clifton E. Oven, *Basic Automotive Service and System*, Delmar Cengage Learning, 2015

F. Lecture Plan:

Lec No	Topics	Session Objective	Mode of Delivery	Corrosponding CO	Mode of Assessing the Outcome
1	Introduction and Course Hand-out briefing	To acquaint and clear teachers expectations and understand student expectations	Lecture	AU1766.1	NA
2	Overview of warranty policies	Understanding basic of vehicle warranty	Lecture	AU1766.1	Class quiz
3,4	various types of warranty offered by OEMs, terms and conditions of warranty	Knowledge of warranties types and their application with different categories	Flipped Class	AU1766.1	Class quiz
5	Benefits and tenure condition of warranty	To aware basics benefits to availing warranties policies.	Activity	AU1766.1	Class quiz
6,7	Claim procedure of settlement in warranty condition Frame Analysis	Knowledge of claim settlement procedure	Lecture, Activity	AU1766.1	Class quiz, Home Assignment
8	claim procedure of settlement in warranty condition Frame Analysis	Knowledge of claim settlement procedure	Lecture	AU1766.1	Home Assignment
9,10	Procedure of processing warranty claim through manual and software.	Working knowledge of warranty software	Lecture, class Flipped	AU1766.1	Class quiz
10	Nomenclature and technical specification of parts numbering make and variant under warranty	Warranty claim filing through parts number	Lecture	AU1766.1	Home Assignment

11	new warranty policies implementation procedure as per warranty manual issued by manufactures	Reading of new warranty polices.	Flipped Class	AU1766.1	Home Assignment
12	Communication procedure of warranty requirement of the newly launched vehicle	Knowledge of commination procedure manufacturing unit for newly launched vehicle	Flipped Class	AU1766.1	Home Assignment
13	various types of failed parts in warranty room	How to arrange various failed parts to avail manufacturing warranty in warranty room.	Flipped Class	AU1766.1	Quiz
14	**Spare Parts Management :** Overview of parts supply chain management,	Knowledge of supply chain management.	Activity (Think Pair Share)	AU1766.2	Quiz
15 - 17	Measurement of performance of OEM	Understanding of measurement performance of OEM parts.		AU1766.2	
18	Technical specification of spare parts issued by OEM and competitors	Reading of technical specification of spare parts issued by manufacturer	Lecture, Activity	AU1766.2	Home Assignment
19 - 20	Knowledge of child parts, recording of parts numbering system and parts terminology Parts catalogue of newly launched vehicle	Application of child parts, numbering system, and terminology of newly launched vehicle.	Lecture	AU1766.2	Quiz
21 - 22	Forecasting demand of parts, cost elements while managing inventory, FIFO Method price negotiation of parts	Implementation of forecasting demand for managing inventory, knowledge of FIFO method.	Lecture		Quiz

				AU1766.2	
23	Payment cycle and order system, knowledge of tax regulation, manual handling technique of parts without assistance	Knowledge of tax regulation, cost and parts handling techniques.	Activity	AU1766.2	Home Assignment
24 - 25	Stock management of parts, , checking incoming parts stock against requirements stock management of parts, , checking incoming parts stock against requirements	Regulation of incoming parts, stock registered maintaining.	Lecture, Flipped class	AU1766.2	Home Assignment
26	New parts location system against new vehicle launch	Identify new location for new parts.	Flipped class	AU1766.2	Quiz

27	Overview of parts management for retro fitment.	Basic concept of retro fitment system.	Lecture	AU1766.2	Quiz
28 - 30	Manage dead and slow moving stocks. Knowledge of profit and loss statement, Delivery of spare parts, damaged parts claim procedure**.**	Management of dead and slow moving stocks, maintaining the profit and loss stamen.	Lecture	AU1766.2	Quiz
31	**Service Advisor :** Estimation of time and cost of materials	Knowledge of estimation of time and cost during making of vehicle job card.	Flipped class	AU1766.3	Home Assignment
32	Customer agreements on job cards and cost estimates, estimation of parts and flat labor rate	Knowledge of estimation of time and cost during making of vehicle job card.	Flipped class	AU1766.3	Home Assignment
33 - 34	Closing of job card after completion of work, service contract under warranty condition offered by the dealership.	Basic knowledge f closing job card after completion of vehicle service.	Lecture	AU1766.3	Home Assignment
35 - 36	Service bulletin issued by manufacturers. Documents under routine service, body repairs and maintenance. AMC offered by	Students will be able to reading of service bulletin.	Lecture	AU1766.3	Home Assignment

	dealership. Access procedure of service bulletin,		Activity		
37 - 38	**Area Technical lead** : Overview of customer feedback system, technical specification of OEM product for service, Planning for better service offering by OEM,	Basic knowledge of customer feedback system and their implementation.	Lecture	AU1766.4 AU1766.4, 1766.5	Quiz
39 - 40	Marketing campaign for effective service delivery, sales tool, customer queries about service offering by OEM	Marketing campaign procedure, customer queries handling.	Lecture Activity (Think Pair Share)	AU1766.4,1766.5	Quiz
41 – 42	**Customer Care**: Activities related to service centre performance enhancement (Expert training, profitability, value added service), Improvement of service level with in dealership network,	Service related activities offering by vehicle service centre.	Lecture	AU1766.6	Home Assignment

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
[1766.1]	Describe concept of vehicle warranty, types and its policies	2						1								
[1766.2]	Explain the functioning of vehicle parts inventory system and their management, role of parts manager.		1	3												
[1766.3]	Describe key role and importance of service advisor , estimation and costing, opening and closing of job card, knowledge of body shop working.				3		2				2					
[1766.4]	**Enhancement of employment and entrepreneurship skill through hands on practice on different automotive sub system**					3										
[1766.5]	Overview of customer feedback system, technical specification of OEM product for service, planning for better service offering to customer.									2						
[1766.6]	Explain activity related to service performance, staff skill enhancement, product performance and feedback		2									2				

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