Feedback for Curriculum

(from stakeholders like Students, Teachers, Employers, Alumni, Academic peers etc.)

(for HME I), Dr. T.K. Bera)

ANNEXURE-I

SAMPLE FILLED STUDENT SURVEY FORMS:

TIET/sur-Form/01/UG

Survey form to assess the level of attainment of student outcomes – Graduating Students

The program of **BE Mechanical Engineering** has been designed with certain student outcomes (the knowledge, skills and attitudes that students develop during the course of study). The students of graduating class are requested to answer the questionnaire given in this form to assess how well they judge they have attained the student outcomes set for the program. Please answer the questionnaire on a scale of 1 to 5 where 1 indicates little achievement or skill, and 5 indicates great deal of achievement.

	SURVEY QUESTIONNAIRE	LEVEL OF ATTAINMENT (answer on a scale of 1 to 5)				
	I have achieved the ability to	1	2	3	4	5
1	apply the knowledge of mathematics, science and engineering fundamentals for solution of complex engineering problems.					✓
2	identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions.					✓
3	design solutions for complex engineering problems and system components/processes considering public health & safety, cultural, societal and environmental aspects.					✓
4	use research-based knowledge and methods including design of experiments, analysis & interpretation of data, and synthesis of the information.					✓
5	create, select, and apply appropriate techniques/ resources/ IT tools to model and predict complex engineering problems within defined constraints.					✓
6	apply contextual reasoning to assess societal, health, safety, legal and cultural issues and the consequent responsibilities					✓
7	understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.					✓
8	apply and commit to professional ethical principles, responsibilities and norms of the engineering practice.					✓
9	function effectively as an individual, as a member or leader in diverse teams and in multidisciplinary settings.					✓
10	communicate effectively on complex engineering activities in terms of comprehension, documentation and presentation.					✓
11	demonstrate the understanding of engineering and management principles and apply these to manage projects in multidisciplinary environments.					✓
12	recognize the need for and to engage in independent and life-long learning in the broadest context of technological change.					✓
PSO 1	Apply mechanical engineering and interdisciplinary knowledge to design, analyse and develop the mechanical systems for addressing the societal needs.					✓
PSO 2	Apply the computational, experimental and soft skills to solve mechanical engineering problems and work coherently in a team to inculcate life-long learning traits.					✓

What do you plan to do after graduation at TIET? Tick (√) whichever is applicable and provide details

a. Employment (give details like employer name): HCL

b. Did you qualify any competitive exam like GATE, NET etc? Please mention NO

c. Higher education (give the title of degree): No

d. Entrepreneur (specify): No

Student Name: Avneesh Singh Regd. No.: 101908119

Graduating Year: 2023

Suggestion, if any: please, Be more specific with things

Survey form to assess the level of attainment of student outcomes – Graduating Students

The program of BE Mechanical Engineering has been designed with certain student outcomes (the knowledge, skills and attitudes that students develop during the course of study). The students of graduating class are requested to answer the questionnaire given in this form to assess how well they judge they have attained the student outcomes set for the program. Please answer the questionnaire on a scale of 1 to 5 where 1 indicates little achievement or skill, and 5 indicates great deal of achievement.

	SURVEY QUESTIONNAIRE	LEVEL OF ATTAINMENT (answer on a scale of 1 to 5)				
	I have achieved the ability to	1	2	3	4	5
1	apply the knowledge of mathematics, science and engineering fundamentals for solution of complex engineering problems.					✓
2	identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions.					✓
3	design solutions for complex engineering problems and system components/processes considering public health & safety, cultural, societal and environmental aspects.					✓
4	use research-based knowledge and methods including design of experiments, analysis & interpretation of data, and synthesis of the information.				✓	
5	create, select, and apply appropriate techniques/ resources/ IT tools to model and predict complex engineering problems within defined constraints.					✓
6	apply contextual reasoning to assess societal, health, safety, legal and cultural issues and the consequent responsibilities					✓
7	understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.				✓	
8	apply and commit to professional ethical principles, responsibilities and norms of the engineering practice.					✓
9	function effectively as an individual, as a member or leader in diverse teams and in multidisciplinary settings.					✓
10	communicate effectively on complex engineering activities in terms of comprehension, documentation and presentation.					✓
11	demonstrate the understanding of engineering and management principles and apply these to manage projects in multidisciplinary environments.					✓
12	recognize the need for and to engage in independent and life-long learning in the broadest context of technological change.					✓
PSO 1	Apply mechanical engineering and interdisciplinary knowledge to design, analyse and develop the mechanical systems for addressing the societal needs.					✓
PSO 2	Apply the computational, experimental and soft skills to solve mechanical engineering problems and work coherently in a team to inculcate life-long learning traits.					✓

What do you plan to do after graduation at TIET? Tick (√) whichever is applicable and provide details

a. Employment (give details like employer name): SAN SERA ENGINEERING

b. Did you qualify any competitive exam like GATE, NET etc? Please mention –

c. Higher education (give the title of degree): –

d. Entrepreneur (specify): –

Student Name: NITIN SHARMA Regd. No.: 101908129

Graduating Year: 2023

Suggestion, if any:

SAMPLE FILLED EMPLOYER SURVEY FORMS:

TIET/sur-Form/03/UG

Survey form to assess the level of attainment of student outcomes – Employer

Dear Sir

We express our sincere thanks for continually employing our graduate students over the years. We are sure our student are sufficiently equipped not only to take on the real world but also make a better place to live in through responsible and innovative use of technology.

We solicit your feedback on attainment of the student outcomes (the knowledge, skills and attitudes that students develop during the course of study at TIET) of the **BE Mechanical/Mechatronics/Production Engineering** program. Please answer the following questions on a scale of 1 to 5 where 1 indicates little achievement or skill, and 5 indicates great deal of achievement.

	SURVEY QUESTIONNAIRE	LEVEL OF ATTAINMENT (answer on a scale of 1 to 5)				
	The student has the ability to	1	2	3	4	5
1	apply the knowledge of mathematics, science and engineering fundamentals for solution of complex engineering problems.				✔	
2	identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions.				✔	
3	design solutions for complex engineering problems and system components/processes considering public health & safety, cultural, societal and environmental aspects.				✔	
4	use research-based knowledge and methods including design of experiments, analysis & interpretation of data, and synthesis of the information.				✔	
5	create, select, and apply appropriate techniques/ resources/ IT tools to model and predict complex engineering problems within defined constraints.					✔
6	apply contextual reasoning to assess societal, health, safety, legal and cultural issues and the consequent responsibilities					✔
7	understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.					✔
8	apply and commit to professional ethical principles, responsibilities and norms of the engineering practice.					✔
9	function effectively as an individual, as a member or leader in diverse teams and in multidisciplinary settings.					✔
10	communicate effectively on complex engineering activities in terms of comprehension, documentation and presentation.				✔	
11	demonstrate the understanding of engineering and management principles and apply these to manage projects in multidisciplinary environments.				✔	
12	recognize the need for and to engage in independent and life-long learning in the broadest context of technological change.					✔

1) What courses/topics would you like to see offered as UG course at TIET or for continuing education to your staff.
   1. *Optimization Techniques for CAE*
   2. *Advance computational methods with programming (MATLAB/Python etc)*
   3. *Basics Of Discretization Techniques.*
2) Overall how satisfied are you with BE Mechanical/Mechatronics/Production Engineering program at TIET and in your opinion how well is the BE Mechanical/Mechatronics/Production Engineering program meeting its stated educational objectives. **EXCELLENT/VERY GOOD/GOOD/AVERAGE/POOR (**Cross-out whichever not applicable.**) : *EXCELLENT** *course structure and one of the leading institute of the country. We expect more talents in coming years in Havells from your institute.*

Vishesh Kumar 12/07/2021

Your Name and Signature with date: Vishesh Kumar (Joint General Manager)

Your Organization Name: Havells India Limited, Common CRI, Sector 59, Noida

Suggestion, if any:_____

Survey form to assess the level of attainment of student outcomes – Employer

Dear Sir

We express our sincere thanks for continually employing our graduate students over the years. We are sure our student ar sufficiently equipped not only to take on the real world but also make a better place to live in through responsible and innovative us of technology.

We solicit your feedback on attainment of the student outcomes (the knowledge, skills and attitudes that students develop durin the course of study at TIET) of the **BE Mechanical/Mechatronics/Production Engineering** program. Please answer the followin questions on a scale of 1 to 5 where 1 indicates little achievement or skill, and 5 indicates great deal of achievement.

	SURVEY QUESTIONNAIRE	LEVEL OF ATTAINMENT (answer on a scale of 1 to 5)				
	The student has the ability to	1	2	3	4	5
1	apply the knowledge of mathematics, science and engineering fundamentals for solution of complex engineering problems.					✓
2	identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions.					✓
3	design solutions for complex engineering problems and system components/processes considering public health & safety, cultural, societal and environmental aspects.				✓	
4	use research-based knowledge and methods including design of experiments, analysis & interpretation of data, and synthesis of the information.					✓
5	create, select, and apply appropriate techniques/ resources/ IT tools to model and predict complex engineering problems within defined constraints.					✓
6	apply contextual reasoning to assess societal, health, safety, legal and cultural issues and the consequent responsibilities					✓
7	understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.					✓
8	apply and commit to professional ethical principles, responsibilities and norms of the engineering practice.					✓
9	function effectively as an individual, as a member or leader in diverse teams and in multidisciplinary settings.					✓
10	communicate effectively on complex engineering activities in terms of comprehension, documentation and presentation.					✓
11	demonstrate the understanding of engineering and management principles and apply these to manage projects in multidisciplinary environments.					✓
12	recognize the need for and to engage in independent and life-long learning in the broadest context of technological change.					✓

1) What courses/topics would you like to see offered as UG course at TIET or for continuing education to your staff.

_____

_____

2) Overall how satisfied are you with BE Mechanical/Mechatronics/Production Engineering program at TIET and in your opinio how well is the BE Mechanical/Mechatronics/Production Engineering program meeting its stated educational objectives **EXCELLENT/VERY GOOD/GOOD/AVERAGE/POOR** (Cross-out whichever not applicable.)

Your Name and Signature with date: Sudhansu Sekhar Padhy (S.S.Padhy)

Your Organization Name: HeromotoCorp Ltd.

Suggestion, if any: — No —

_____

SAMPLE FILLED ALUMNI SURVEY FORM

TIET/sur-Form/02/UG

Survey form to assess the level of attainment of student outcomes – Alumni

Dear Alumni,

It is wonderful to reconnect with you after a few years. We hope you have been doing exceedingly well in your career. We are sure that your stay with TIET has enabled you to imbibe the process of life-long learning and to take up challenging careers. We are sure you were sufficiently equipped not only to take on the real world but also make it a better place to live in through responsible and innovative use of technology. We need your support to keep the TIET flag flying high.

We solicit your feedback on attainment of the student outcomes (the knowledge, skills and attitude that you developed during the course of study at TIET and subsequent work experiences) of the **BE Mechanical/Mechatronics/Production Engineering program**. Please answer the following questions on a scale of 1 to 5 where 1 indicates little achievement or skill and 5 indicates great deal of achievement.

	SURVEY QUESTIONNAIRE	LEVEL OF ATTAINMENT (answer on a scale of 1 to 5)				
	I achieved an ability to	1	2	3	4	5
1	apply the knowledge of mathematics, science and engineering fundamentals for solution of complex engineering problems					✓
2	identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions				✓	
3	design solutions for complex engineering problems and system components/processes considering public health & safety, cultural, societal and environmental aspects					✓
4	use research-based knowledge and methods including design of experiments, analysis & interpretation of data, and synthesis of the information					✓
5	create, select, and apply appropriate techniques/ resources/ IT tools to model and predict complex engineering problems within defined constraints					✓
6	apply contextual reasoning to assess societal, health, safety, legal and cultural issues and the consequent responsibilities				✓	
7	understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development					✓
8	apply and commit to professional ethical principles, responsibilities and norms of the engineering practice			✓		
9	function effectively as an individual, as a member or leader in diverse teams and in multidisciplinary settings				✓	
10	communicate effectively on complex engineering activities in terms of comprehension, documentation and presentation					✓
11	demonstrate the understanding of engineering and management principles and apply these to manage projects in multidisciplinary environments				✓	
12	recognize the need for and to engage in independent and life-long learning in the broadest context of technological change			✓		

Note: Cross-out whichever not applicable

1) GATE exam (if any): PASSED/FAILED/NOT TAKEN
2) Promotion since graduation: YES/NO
3) Enrolment in higher studies: YES/NO if YES (please answer following)
   i) Name of program ——— ii) Year of completion ———
4) Involvement in professional societies, if any
5) Community service, if any
6) Overall how satisfied are you with BE Mechanical/Mechatronics/Production Engineering program at TIET and in your opinion how well is the BE Mechanical/Mechatronics/Production Engineering program meeting its stated educational objectives
   EXCELLENT/VERY GOOD/GOOD/AVERAGE/POOR

Your Name with signature: Abhay Kapur Your current organization: Escorts Limited

Regd No.: [illegible] Year of graduation: 2015

Suggestion, if any: ———

[illegible] 1/2

(for HMED, Dr. T.K. Bera)

Course Outcomes and Program Outcomes (2022-2023)

Course Outcomes (COs): Each Course leads to some Course Outcomes. These are the statements indicating abilities that student would acquire after the successful completion of a course. The CO statements are defined by considering the course content covered in each module of a course. The keywords used to define COs are based on Bloom's Taxonomy.

Program Outcomes (POs): Program outcomes describe what students are expected to know and would be able to do by the time of graduation. These relate to the skills, knowledge, and behaviours that students acquire as they progress through the program.

Program Specific Outcomes (PSOs): Program Specific Outcomes are statements that describe unique abilities the graduates of a specific engineering program from TIET will acquire.

1.1 Establish the correlation between the courses and the Program Outcomes (POs) & Program Specific Outcomes

Mechanical Engineering Program has twelve Program outcomes (POs) as defined by NBA and two Program Specific Outcomes (PSOs).

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
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 public health and safety, and cultural, societal, and environmental considerations.
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.
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.
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.
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.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
9. **Individual and Teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
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.
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.
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 (PSOs) as defined by the program are:

- Apply mechanical engineering and interdisciplinary knowledge to design, analyse and develop mechanical systems for addressing societal needs.
- Apply computational, experimental and soft skills to solve mechanical engineering problems and work coherently in a team to inculcate life-long learning traits.

Program Articulation Matrix: The contribution of the courses in Mechanical Engineering Program for attainment of Program Outcomes (POs) and Program Specific Outcomes (PSOs) (Program Articulation Matrix) is shown in Table B.1.1a. *Table B.1.1a* gives the summary of weight factors of various courses towards defined PO/PSOs. The weight factor W_{ij} is defined as $\boldsymbol{W_{ij} = \frac{\sum_1^k W\_CO_{ik}}{k}}$, where $\boldsymbol{W\_CO_{Ik}}$ is the correlation of the k^{th} CO of the i^{th} course towards fulfilment of j^{th} PO/PSO, as defined in *Table B.1.1b.*

Table B.1.1a

COURSE NO.	COURSE NAME	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
UEC001	ELECTRONIC ENGINEERING	2.80	-	-	2.00	2.20	-	-	-	1.80	-	-	-	-	-
UHU003	PROFESSIONAL COMMUNICATION	-	-	-	-	-	-	-	-	-	2.60	-	-	-	-
UMA010	MATHEMATICS – I	2.25	-	-	-	-	-	-	-	-	-	-	-	-	-
UPH004	APPLIED PHYSICS	3.00	-	2.00	-	-	-	-	-	-	-	-	1.00	-	-
UTA015	ENGINEERING DRAWING	3.00	-	-	-	3.00	-	-	-	2.33	-	-	-	2.00	2.00
UTA003	COMPUTER PROGRAMMING	3.00	2.00	2.50	2.50	2.50	-	-	3.00	3.00	-	2.50	3.00	2.00	3.00
UCB008	APPLIED CHEMISTRY	3.00	2.00	-	-	-	1.00	1.00	-	-	-	-	2.00	-	-
UEE001	ELECTRICAL ENGINEERING	2.80	2.80	-	-	-	-	-	-	2.00	-	-	-	-	-
UEN002	ENERGY AND ENVIRONMENT	1.00	-	2.50	-	-	1.00	2.50	-	-	-	-	-	-	-
UES009	MECHANICS	2.33	2.33	-	-	-	-	-	-	-	-	-	-	1.67	-
UMA004	MATHEMATICS – II	2.75	-	-	-	-	-	-	-	-	-	-	-	-	-
UTA016	ENGINEERING DESIGN PROJECT – I	3.00	2.33	1.67	2.00	2.17	2.50	2.00	2.50	1.80	1.40	2.50	2.00	1.75	3.00
UTA027	ARTIFICIAL INTELLIGENCE	3.00	3.00	2.75	-	3.00	-	-	-	-	-	-	2.75	-	3.00
UTA024	ENGINEERING DESIGN PROJECT-II	2.80	2.40	2.40	2.20	2.20	-	-	-	3.00	2.60	2.00	2.80	-	-
UTA026	MANUFACTURING PROCESSES	3.00	2.00	-	-	-	-	-	-	2.25	-	-	2.00	-	1.00
UES017	SOLID AND STRUCTURES	2.25	2.50	-	-	-	-	-	-	-	-	-	-	2.00	-
UME307	ENGINEERING FLUID MECHANICS	3.00	3.00	-	-	-	-	-	-	-	-	-	-	3.00	-
UME308	MECHANICS OF MACHINES	2.40	2.60	-	-	-	-	-	-	-	-	2.00	-	2.00	2.00
UTA025	INNOVATION AND ENTREPRENEURSHIP	-	2.00	2.50	-	2.33	2.00	2.00	-	3.00	3.00	2.67	2.00	-	-
UMA034	OPTIMIZATION METHODS	2.00	1.00	-	-	-	-	-	-	-	-	3.00	-	-	-
UES401	BASICS OF MATERIALS SCIENCE	2.00	-	3.00	-	-	-	-	-	-	-	-	-	2.00	-
UMA011	NUMERICAL ANALYSIS	2.00	2.00	-	-	-	-	-	-	-	-	-	1.00	-	-
UME404	MECHANICS OF DEFORMABLE BODIES	3.00	2.17	-	-	-	-	-	-	2.00	2.00	-	2.00	2.00	1.80
UME410	MECHATRONIC SYSTEMS	2.67	3.00	3.00	3.00	3.00	-	-	-	-	3.00	-	-	3.00	2.50
UME412	COMPUTER AIDED DESIGN AND ANALYSIS	2.00	-	2.00	2.00	3.00	-	-	-	3.00	2.00	-	1.00	3.00	-
UES004	THERMODYNAMICS	3.00	2.00	-	-	-	-	-	-	-	-	-	-	-	-
UME515	INDUSTRIAL ENGINEERING	1.50	2.00	-	2.00	3.00	-	-	-	-	-	-	-	-	2.00
UME408	MACHINE DESIGN-I	2.20	2.20	1.60	-	-	-	-	-	2.00	2.00	-	-	2.00	1.25

UME718	APPLIED THERMODYNAMICS	2.50	2.00	-	-	-	-	-	-	2.00	1.00	-	-	1.00	-
UME509	MANUFACTURING TECHNOLOGY	1.00	2.00	-	-	-	-	-	-	-	-	-	-	1.00	2.00
UME517	MATERIALS ENGINEERING & METALLURGY	2.00	2.00	-	2.00	-	-	-	-	-	2.00	-	2.00	2.00	1.00
UME511	AUTOMOBILE ENGINEERING	3.00	-	-	-	-	2.00	2.50	-	-	-	-	2.00	1.00	2.00
UME700	GROUP PROJECT	-	3.00	3.00	-	-	2.00	-	-	2.25	2.50	-	-	2.00	-
UPE602	SUPPLY CHAIN MANAGEMENT	3.00	3.00	-	3.00	3.00	-	-	-	-	-	3.00	-	3.00	-
UPE601	FACILITY PLANNING	-	3.00	2.00	2.00	2.25	-	-	-	2.00	-	2.00	2.00	2.00	2.00
UME699	PROJECT SEMESTER	3.00	3.00	3.00	3.00	-	-	-	-	-	3.00	3.00	3.00	-	-
UME707	MACHINE DESIGN-II	2.67	2.00	1.83	-	-	-	-	-	3.00	2.00	-	-	2.25	2.00
UME720	HEAT TRANSFER	3.00	3.00	1.00	1.67	1.00	-	-	-	-	2.33	-	-	-	2.00
UME719	REFRIGERATION AND AIR CONDITIONING	2.60	1.00	1.60	-	2.00	2.60	-	1.00	-	-	-	2.20	2.00	-
UHU005	HUMANITIES FOR ENGINEERS	-	-	-	-	-	2.00	-	3.00	2.00	2.00	2.00	-	-	-
UME723	FLUID MACHINES	3.00	2.00	-	-	-	-	-	-	-	-	-	-	-	-
UME513	DYNAMICS AND VIBRATIONS	3.00	2.25	-	-	2.00	-	-	-	2.00	-	-	1.00	2.00	2.00
UME793	CAPSTONE PROJECT	2.60	2.25	2.33	2.50	2.50	1.80	2.00	1.80	2.20	2.67	2.00	2.00	1.80	2.00
UME518	INTRODUCTION TO ROBOTICS	3.00	2.00	2.00	-	1.00	-	-	-	-	-	-	1.00	2.00	2.00
UME525	VEHICLE DYNAMICS	3.00	2.00	2.00	-	3.00	1.00	-	-	2.00	-	-	1.00	2.00	2.00
UME524	ADDITIVE MANUFACTURING	2.00	2.50	2.75	2.00	3.00	-	-	-	1.00	-	-	2.00	2.00	2.00
UME839	RENEWABLE ENERGY SYSTEMS	2.00	2.40	1.60	1.40	-	-	-	-	-	-	-	-	1.80	1.60
UPE705	COMPUTER AIDED MANUFACTURING	3.00	3.00	3.00	3.00	3.00	3.00	2.00	2.00	2.00	2.00	1.00	3.00	3.00	3.00
UME737	CONDITION MONITORING OF ROTATING MACHINES	2.67	2.33	1.50	-	2.00	-	-	-	2.00	-	-	-	1.67	2.00
UME722	SYSTEM MODELLING AND SIMULATION	3.00	3.00	-	-	-	-	-	-	-	-	-	-	3.00	3.00
UME857	ADVANCED MECHANICAL VIBRATION	3.00	2.67	2.00	-	2.00	-	-	-	-	-	-	-	2.33	2.00
UME841	MODERN AUTOMOBILE ENGINEERING	-	-	-	-	3.00	2.67	-	-	-	-	-	3.00	3.00	2.00
UME856	TOTAL QUALITY MANAGEMENT	3.00	3.00	3.00	2.67	-	-	-	-	-	-	2.50	-	-	-
UPE703	METAL FORMING	2.75	2.00	3.00	2.00	-	-	-	-	2.50	-	-	1.00	1.00	1.00
UME836	OPERATIONS MANAGEMENT	1.67	-	-	-	1.67	-	-	-	2.00	-	-	-	-	-
UPE503	LEAN AND AGILE MANUFACTURING	2.60	2.33	1.67	1.67	3.00	-	2.00	-	-	2.00	-	-	2.00	2.33
UME831	COMPUTATIONAL FLUID DYNAMICS	3.00	3.00	3.00	-	3.00	-	-	-	-	-	-	-	-	3.00
UME853	SOLAR ENERGY ENGINEERING	2.60	2.00	-	-	-	-	2.00	-	-	-	-	-	3.00	-

Course Articulation Matrix: The contribution of Course Outcomes (CO) for attainment of Program Outcomes (POs) and Program Specific Outcomes (PSOs) is shown by correlation between Course Outcomes and POs and PSOs (Course Articulation Matrix) in Table B.1.1b.

Table B.1.1b

COURSE No.	COURSE NAME	CLO NO.	CLOs STATEMENT	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
UEC001	ELECTRONIC ENGINEERING	UEC001.1	Demonstrate the use of semiconductor diodes in various applications.	3	-	-	2	3	-	-	-	2	-	-	-	-	-
		UEC001.2	Discuss and explain the working of transistors and operational amplifiers, as well as their configurations and applications.	3	-	-	3	3	-	-	-	2	-	-	-	-	-
		UEC001.3	Recognize and apply the number systems and Boolean algebra.	3	-	-	2	1	-	-	-	2	-	-	-	-	-
		UEC001.4	Reduce Boolean expressions and implement them with Logic Gates.	3	-	-	2	1	-	-	-	2	-	-	-	-	-
		UEC001.5	Analyze, design and implement combinational and sequential circuits.	2	-	-	1	3	-	-	-	1	-	-	-	-	-
UHU003	PROFESSIONAL COMMUNICATION	UHU003.1	Apply communication concepts for effective interpersonal communication.	-	-	-	-	-	-	-	-	-	2	-	-	-	-
		UHU003.2	Select the most appropriate media of communication for a given situation.	-	-	-	-	-	-	-	-	-	3	-	-	-	-
		UHU003.3	Speak assertively and effectively.	-	-	-	-	-	-	-	-	-	3	-	-	-	-
		UHU003.4	Write objective organizational correspondence.	-	-	-	-	-	-	-	-	-	2	-	-	-	-
		UHU003.5	Design effective resumes, reports and proposals.	-	-	-	-	-	-	-	-	-	3	-	-	-	-

UMA010	MATHEMATICS – I	UMA010.1	examine functions of several variables, define and compute partial derivatives, directional derivatives and their use in finding maxima and minima in some engineering problems.	2	-	-	-	-	-	-	-	-	-	-	-	-	-
		UMA010.2	evaluate multiple integrals in Cartesian and Polar coordinates, and their applications to engineering problems.	2	-	-	-	-	-	-	-	-	-	-	-	-	-
		UMA010.3	determine the convergence/divergence of infinite series, approximation of functions using power and Taylor's series expansion and error estimation.	2	-	-	-	-	-	-	-	-	-	-	-	-	-
		UMA010.4	represent complex numbers in Cartesian and Polar forms and test the analyticity of complex functions by using Cauchy-Riemann equations.	3	-	-	-	-	-	-	-	-	-	-	-	-	-
UPH004	APPLIED PHYSICS	UPH004.1	Understand damped and simple harmonic motion, the role of reverberation in designing a hall and generation and detection of ultrasonic waves.	3	-	2	-	-	-	-	-	-	-	-	1	-	-
		UPH004.2	Use Maxwell's equations to describe propagation of EM waves in a medium.	3	-	2	0	-	-	-	-	-	-	-	-	-	-
		UPH004.3	Demonstrate interference, diffraction and polarization of light.	3	-	-	-	-	-	-	-	-	-	-	-	-	-
		UPH004.4	Explain the working principle of Lasers.	3	-	-	-	-	-	-	-	-	-	-	1	-	-
		UPH004.5	Use the concept of wave function to find probability of a particle confined in a box.	3	-	-	-	-	-	-	-	-	-	-	-	-	-
UTA015	ENGINEERING DRAWING	UTA015.1	creatively comprehend the geometrical details of common engineering objects	3	-	-	-	-	-	-	-	3	-	-	-	2	-

		UTA015.2	draw dimensioned orthographic and isometric projections of simple engineering objects	3	-	-	-	-	-	-	-	3	-	-	-	2	-
		UTA015.3	interpret the meaning and intent of limits, fits and tolerances in the drawing	3	-	-	-	-	-	-	-	1	-	-	-	-	-
		UTA015.4	create/edit the engineering drawings for simple engineering objects using 2D drafting software	-	-	-	-	3	-	-	-	-	-	-	-	-	-
		UTA015.5	create/edit 3D models of engineering components using 3D modelling software.	-	-	-	-	3	-	-	-	-	-	-	-	-	2
UTA003	COMPUTER PROGRAMMING	UTA003.1	comprehend concepts related to computer hardware and software, draw flowcharts and write algorithm/pseudocode.	3	2	-	-	3	-	-	3	3	-	2	3	2	3
		UTA003.2	write, compile and debug programs in C language, use different data types, operators and console I/O function in a computer program	3	2	-	-	3	-	-	3	3	-	2	3	2	3
		UTA003.3	design programs involving decision control statements, loop control statements, case control structures, arrays, strings, pointers, functions and implement the dynamics of memory by the use of pointers.	3	2	3	3	2	-	-	3	3	-	3	3	2	3
		UTA003.4	comprehend the concepts of linear and Non-Linear data structures by implementing linked lists, stacks and queues.	3	2	2	2	2	-	-	3	3	-	3	3	2	3
UCB008	APPLIED CHEMISTRY	UCB008.1	concepts of electrodes in electrochemical cells, migration of ions, liquid junction potential and conductometric titrations	3	2	-	-	-	1	1	-	-	-	-	2	-	-
		UCB008.2	atomic and molecular spectroscopy fundamentals like Beer`s law, flame photometry, atomic absorption spectrophotometry, UV-Vis and IR	3	2	-	-	-	1	1	-	-	-	-	2	-	-
		UCB008.3	water and its treatment methods like lime soda and ion exchange	3	2	-	-	-	1	1	-	-	-	-	2	-	-

		UCB008.4	concept of phase rule, fuel quality parameters and alternative fuels	3	2	-	-	-	1	1	-	-	-	-	2	-	-
		UCB008.5	polymerization, molecular weight determination and applications as biodegradable and conducting polymers	3	2	-	-	-	1	1	-	-	-	-	2	-	-
		UCB008.6	laboratory techniques like pH metry, potentiometry, colourimetry, conductometry and volumetry	3	2	-	-	-	1	1	-	-	-	-	2	-	-
UEE001	ELECTRICAL ENGINEERING	UEE001.1	Apply networks laws and theorems to solve electric circuits.	3	3	-	-	-	-	-	-	2	-	-	-	-	-
		UEE001.2	Analyze transient and steady state response of DC circuits.	3	3	-	-	-	-	-	-	-	-	-	-	-	-
		UEE001.3	Signify AC quantities through phasor and compute AC system behaviour during steady state	3	3	-	-	-	-	-	-	-	-	-	-	-	-
		UEE001.4	Expalin and analyze the behaviour of transformer	3	3	-	-	-	-	-	-	2	-	-	-	-	-
		UEE001.5	Elucidate the principle and charcteristics of DC motor and DC generator	2	2	-	-	-	-	-	-	2	-	-	-	-	-
UEN002	ENERGY AND ENVIRONMENT	UEN002.1	Comprehend the interdisciplinary context with reference to the environmental issues and case studies	1	-	-	-	-	1	3	-	-	-	-	-	-	-
		UEN002.2	Assess the impact of anthropogenic activities on the various elements of environment and apply suitable techniques to mitigate their impact.	1	-	2	-	-	1	3	-	-	-	-	-	-	-
		UEN002.3	Conceptualise and explain the structural and functional features of ecological systems	1	-	-	-	-	1	2	-	-	-	-	-	-	-
		UEN002.4	Correlate environmental concerns with the conventional energy sources associated and assess the uses and limitations of non-conventional energy technologies	1	-	3	-	-	1	2	-	-	-	-	-	-	-
UES009	MECHANICS	UES009.1	determine resultants in plane force systems	3	3	-	-	-	-	-	-	-	-	-	-	2	-

		UES009.2	identify and quantify all forces associated with a static framework	2	2	-	-	-	-	-	-	-	-	-	-	2	-
		UES009.3	draw Shear Force Diagram and Bending Moment Diagram in various kinds of beams subjected to different kinds of loads	2	2	-	-	-	-	-	-	-	-	-	-	1	-
UMA004	MATHEMATICS – II	UMA004.1	solve the differential equations of first and 2nd order and basic application problems described by these equations.	3	-	-	-	-	-	-	-	-	-	-	-	-	-
		UMA004.2	determine the Laplace transformations and inverse Laplace transformations of various functions and its applications to solve initial value and boundary value problems.	3	-	-	-	-	-	-	-	-	-	-	-	-	-
		UMA004.3	determine the Fourier series expansions of periodic functions and its applications to solve second order partial differential equations such as such as wave/heat equations.	3	-	-	-	-	-	-	-	-	-	-	-	-	-
		UMA004.4	solve systems of linear equations by using elementary row operations and identify the vector spaces/subspaces to compute their bases. Further, students will be able to express linear transformation in terms of matrix and find the eigen values and vectors	2	-	-	-	-	-	-	-	-	-	-	-	-	-
UTA016	ENGINEERING DESIGN PROJECT – I	UTA016.1	simulate trajectories of a mass with and without aerodynamic drag using a spreadsheet based software tool to allow trajectories be optimized	3	2	1	-	1	-	-	-	-	1	-	-	1	-
		UTA016.2	perform a test to acquire an engineering material property of strength in bending and analyze the throwing arm of the “Mangonel” under conditions of static and dynamic loading;	3	3	1	1	2	-	-	-	1	1	-	-	1	-
		UTA016.3	develop and test software code to process sensor data	3	2	1	-	3	-	-	-	1	1	-	-	-	-

		UTA016.4	design, construct and test an electronic hardware solution to process sensor data	3	2	1	-	3	-	-	-	1	1	-	-	-	-
		UTA016.5	Construct and operate a Roman catapult “Mangonel” using tools, materials and assembly instructions, in a group, for a competition.	3	2	3	-	1	2	1	2	3	-	2	1	2	3
		UTA016.6	Operate and evaluate the innovative redesign of elements of the “Mangonel” for functional and structural performance.	3	3	3	3	3	3	*3*	3	3	3	3	3	3	3
UTA027	ARTIFICIAL INTELLIGENCE	UTA027.1	Comprehend the basics of Artificial Intelligence and representing various problem domains using knowledge representation schemes.	3	3	2	-	-	-	-	-	-	-	-	2	-	3
		UTA027.2	Apply various artificial intelligence techniques for obtaining solutions to real-life problems.	3	3	3	-	3	-	-	-	-	-	-	3	-	3
		UTA027.3	Understand the fundamentals of neural networks, machine learning, and computer vision.	3	3	3	-	3	-	-	-	-	-	-	3	-	3
		UTA027.4	Comprehend the applicability of Artificial Intelligence techniques in real world.	3	3	3	-	3	-	-	-	-	-	-	3	-	3
UTA024	ENGINEERING DESIGN PROJECT-II	UTA024.1	Recognize issues to be addressed in a combined hardware and software system design.	3	3	2	2	2	-	-	-	3	1	1	3	-	-
		UTA024.2	Draw the schematic diagram of an electronic circuit and design its PCB layout using CAD Tools.	3	2	3	2	3	-	-	-	3	3	2	3	-	-
		UTA024.3	Apply hands-on experience in electronic circuit implementation and its testing.	3	3	3	2	2	-	-	-	3	3	2	3	-	-
		UTA024.4	Demonstrate programming skills by integrating coding, optimization and debugging for different challenges.	3	2	2	3	2	-	-	-	3	3	3	3	-	-
		UTA024.5	Develop group working, including task sub-division and integration of individual contributions from the team.	2	2	2	2	2	-	-	-	3	3	2	2	-	-

UTA026	MANUFACTURING PROCESSES	UTA026.1	develop simple CNC code, and use it to produce components while working in groups.	3	2	-	-	-	-	-	-	3	-	-	2	-	1
		UTA026.2	analyse various machining processes and calculate relevant quantities such as velocities, forces.	3	2	-	-	-	-	-	-	-	-	-	2	-	-
		UTA026.3	recognise cutting tool wear and identify possible causes and solutions.	3	2	-	-	-	-	-	-	-	-	-	2	-	-
		UTA026.4	understand the basic principle of bulk and sheet metal forming operations for analysis of forces.	3	2	-	-	-	-	-	-	2	-	-	2	-	1
		UTA026.5	analyse various shearing operations for tooling design.	3	2	-	-	-	-	-	-	-	-	-	2	-	-
		UTA026.6	apply the knowledge of metal casting for different requirements.	3	2	-	-	-	-	-	-	2	-	-	2	-	1
		UTA026.7	analyse and understand the requirements to achieve sound welded joint while welding different similar and dissimilar engineering materials.	3	2	-	-	-	-	-	-	2	-	-	2	-	1
UES017	SOLID AND STRUCTURES	UES017.1	Evaluate axial stresses and strains in various determinate and indeterminate structural systems	3	3	-	-	-	-	-	-	-	-	-	-	2	-
		UES017.2	Calculate load carrying capacity of columns and struts and their buckling strength	2	2	-	-	-	-	-	-	-	-	-	-	2	-
		UES017.3	To study the effect of combined stresses and strains	2	3	-	-	-	-	-	-	-	-	-	-	2	-
		UES017.4	Determine deformations and deflections in various kinds of beams and trusses	2	2	-	-	-	-	-	-	-	-	-	-	2	-
UME307	ENGINEERING FLUID MECHANICS	UME307.1	Analyze and solve the problems of fluid interaction with solid surfaces in static condition.	3	3	-	-	-	-	-	-	-	-	-	-	3	-
		UME307.2	Derive and solve the description of fluid kinematics problems and determination of	3	3	-	-	-	-	-	-	-	-	-	-	3	-

			dimensionless groups using Buckingham's Pi method.																
		UME307.3	Derive and solve(simplified cases) the governing equations for fluid flow (Navier-Stokes equation).	3	3	-	-	-	-	-	-	-	-	-	-	3	-
		UME307.4	Analyze and solve the internal and external flows problems.	3	3	-	-	-	-	-	-	-	-	-	-	3	-
UME308	MECHANICS OF MACHINES	UME308.1	Analyse a set of mechanisms to achieve desired motion transformation.	2	3	-	-	-	-	-	-	-	-	-	-	2	-
		UME308.2	Apply analytical methods for the evaluation of velocity and acceleration of mechanisms.	3	2	-	-	-	-	-	-	-	-	2	-	-	2
		UME308.3	Analyse and construct cam profiles for different motion of follower.	2	2	-	-	-	-	-	-	-	-	-	-	2	-
		UME308.4	Evaluate the unbalance in rotating/reciprocating systems and carry out their balancing.	2	3	-	-	-	-	-	-	-	-	-	-	-	-
		UME308.5	Formulate equations of motion, evaluate the responses of different real life vibration	3	3	-	-	-	-	-	-	-	-	-	-	-	-
UTA025	INNOVATION AND ENTREPRENEURSHIP	UTA025.1	Explain the fundamentals behind the entrepreneurial personality and their intentions	-	-	-	-	-	3	-	-	3	3	3	2	-	-
		UTA025.2	Discover/create and evaluate opportunities	-	2	3	-	3	1	2	-	3	3	-	2	-	-
		UTA025.3	Identify various stakeholders for the idea and develop value proposition for the same.	-	-	-	-	-	-	-	-	3	3	-	2	-	-
		UTA025.4	Describe various Business Models and design a business model canvas.	-	-	-	-	2	2	-	-	3	3	2	2	-	-
		UTA025.5	Analyse and select suitable finance and revenue models for start-up venture.	-	2	2	-	2	-	-	-	3	3	3	2	-	-

UMA034	OPTIMIZATION METHODS	UMA034.1	Formulate and solve linear programming problems using Simplex method and its variants.	2	1	-	-	-	-	-	-	-	-	-	-	-	-
		UMA034.2	Solve linear goal programming problem graphically.	2	-	-	-	-	-	-	-	-	-	-	-	-	-
		UMA034.3	Construct and optimize various network models	-	-	-	-	-	-	-	-	-	-	3	-	-	-
		UMA034.4	To study two-person zero sum game and its solutions.	2	-	-	-	-	-	-	-	-	-	-	-	-	-
		UMA034.5	Classify and modeling of queuing system.	2	-	-	-	-	-	-	-	-	-	-	-	-	-
UES401	BASICS OF MATERIALS SCIENCE	UES401.1	Classify engineering materials based on its structure.	1	-	3	-	-	-	-	-	-	-	-	-	-	-
		UES401.2	Draw crystallographic planes and directions.	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		UES401.3	Select an appropriate strengthening mechanism to enhance the strength of the material.	3	-	3	-	-	-	-	-	-	-	-	-	2	-
		UES401.4	Classify materials based on their electrical and magnetic properties.	2	-	-	-	-	-	-	-	-	-	-	-	-	-
		UES401.5	Propose a solution to prevent corrosion.	-	-	3	-	-	-	-	-	-	-	-	-	-	-
UMA011	NUMERICAL ANALYSIS	UMA011.1	learn how to obtain numerical solution of nonlinear equations using bisection, secant, Newton, and fixed-point iteration methods.	2	2	-	-	-	-	-	-	-	-	-	1	-	-
		UMA011.2	solve system of linear equations numerically using direct and iterative methods.	2	2	-	-	-	-	-	-	-	-	-	1	-	-
		UMA011.3	learn how to approximate the functions using interpolating polynomials.	2	2	-	-	-	-	-	-	-	-	-	1	-	-
		UMA011.4	learn how to solve definite integrals and initial value problems numerically.	2	2	-	-	-	-	-	-	-	-	-	1	-	-
UME404	MECHANICS OF DEFORMABLE BODIES	UME404.1	calculate the state of stress at the critical point of the object	3	2	-	-	-	-	-	-	-	-	-	-	2	2
		UME404.2	establish 3D stress-strain relationship for isotropic materials	3	2	-	-	-	-	-	-	-	-	-	-	2	2

		UME404.3	conduct the failure analysis under static loading in ductile and brittle materials using different theories of failures	3	2	-	-	-	-	-	-	-	-	-	-	2	2
		UME404.4	calculate deflection at any point on a solid structure using Castigliano's theorems	3	2	-	-	-	-	-	-	-	-	-	-	2	2
		UME404.5	determine the distribution of circumferential and radial stress along the thickness of thick cylinders	3	2	-	-	-	-	-	-	-	-	-	-	-	-
		UME404.6	model and analyze real structures or engineering systems through projects/assignments	3	3	-	-	-	-	-	-	2	2	-	2	2	1
UME410	MECHATRONIC SYSTEMS	UME410.1	calculate the output to input relation of any physical model in the form of a transfer function using block siagram and signal flow graphs	3	3	3	-	-	-	-	-	-	-	-	-	3	2
		UME410.2	develop the block diagram of any mechatronic system after analyzing the key inputs, outputs, sensors, transducers and controllers of any physical device	2	3	3	-	3	-	-	-	-	-	-	-	3	-
		UME410.3	interface different sensors, actuators, micro-controllers and data acquisition cards of a given mechatronic device to the computer/laptop	-	-	-	3	-	-	-	-	-	3	-	-	-	3
		UME410.4	develop the state-space representation of the physical model and analyze the performance and stability of the system in MATLAB environment	3	3	3	-	3	-	-	-	-	-	-	-	-	2
		UME410.5	analyze the key features of different type of controllers and develop a suitable controller to obtain the desired performance from the system	-	-	-	-	3	-	-	-	-	-	-	-	-	3

UME412	COMPUTER AIDED DESIGN AND ANALYSIS	UME412.1	interpret mechanical drawings for components, assemblies and use parametric 3D CAD software tools in the correct manner for creating their geometric part models, assemblies and automated drawings	2	-	-	-	3	-	-	-	-	-	-	1	-	-
		UME412.2	create assembly of mechanism from schematic or component drawing and conduct position/ path/ kinematic / dynamic analysis of a mechanism in motion using CAD software tools	2	-	-	2	-	-	-	-	-	-	-	-	-	-
		UME412.3	evaluate design and create an optimized solution using commercial CAD, CAE software as black box for required analysis of mass properties/ stress, deflection / temperature distribution etc under realistic loading and constraining conditions	-	-	2	-	3	-	-	-	3	-	-	1	3	-
		UME412.4	produce design reports for Geometric modelling, Assembly, drawings, analysis, evaluation of results, reflection and suggestions for design evaluation and improvement	-	-	-	2	3	-	-	-	3	2	-	-	-	-
UES004	THERMODYNAMICS	UES004.1	analyze and solve problems related to closed systems and steady-flow devices by applying the conservation of energy principle	3	2	-	-	-	-	-	-	-	-	-	-	-	-
		UES004.2	analyze the second law of thermodynamics for various systems and to evaluate the performance of heat engines, refrigerators and heat pumps	3	2	-	-	-	-	-	-	-	-	-	-	-	-
		UES004.3	estimate vapor-liquid properties and solve basic problems using steam tables, Mollier diagrams and equation of state	3	2	-	-	-	-	-	-	-	-	-	-	-	-
		UES004.4	apply the first and second laws of thermodynamics for the complete	3	2	-	-	-	-	-	-	-	-	-	-	-	-

			thermal analysis of vapor power cycle														
UME515	INDUSTRIAL ENGINEERING	UME515.1	obtain productivity indices to evaluate effectiveness of resource utilization	-	-	-	2	-	-	-	-	-	-	-	-	-	-
		UME515.2	analyze line balancing issues in a product layout for improving cycle times	-	2	-	-	-	-	-	-	-	-	-	-	-	1
		UME515.3	apply quality engineering tools for process control and improvement	2	-	-	-	3	-	-	-	-	-	-	-	-	3
		UME515.4	develop a production schedule using information/data from different functional areas	-	2	-	-	-	-	-	-	-	-	-	-	-	-
		UME515.5	determine the time standards using work study principles/human factors in engineering	1	-	-	-	-	-	-	-	-	-	-	-	-	-
UME408	MACHINE DESIGN-I	UME408.1	select the suitable materials and manufacturing considerations.	2	2	2	-	-	-	-	-	-	-	-	-	2	1
		UME408.2	calculate stresses involved with static/ fatigue loading	2	2	2	-	-	-	-	-	-	-	-	-	2	2
		UME408.3	represent machine elements with a free body diagram and solve for unknown reactions	3	3	2	-	-	-	-	-	-	-	-	-	-	-
		UME408.4	conduct a failure analysis for the design/sizing of mechanical components	2	2	1	-	-	-	-	-	-	-	-	-	2	1
		UME408.5	design and analyze a real engineering system through projects/assignments	2	2	1	-	-	-	-	-	2	2	-	-	2	1
UME718	APPLIED THERMODYNAMICS	UME718.1	Derive and analyze Otto Cycle, Diesel cycle and Dual cycle air standard efficiencies.	3	2	-	-	-	-	-	-	-	-	-	-	-	-
		UME718.2	Derive and analyze simple Brayton cycle.	3	2	-	-	-	-	-	-	-	-	-	-	-	-
		UME718.3	Determine and analyze the performance parameters of I.C. engines in an engine test rig.	2	2	-	-	-	-	-	-	2	1	-	-	1	-
		UME718.4	To prepare heat balance sheet of the boiler.	2	2	-	-	-	-	-	-	-	-	-	-	-	-

UME509	MANUFACTURING TECHNOLOGY	UME509.1	Estimate the forces, power and energy requirements during forging and rolling	1	2	-	-	-	-	-	-	-	-	-	-	-	2
		UME509.2	Recognize the manufacturing processes for processing of plastics & ceramics	1	2	-	-	-	-	-	-	-	-	-	-	1	-
		UME509.3	Identify suitable casting technique for a particular application based on the differentiation in process salient feature	1	2	-	-	-	-	-	-	-	-	-	-	1	-
		UME509.4	Design the gating and riser system for the casting process and calculate the charge constituents in liquid metal	1	2	-	-	-	-	-	-	-	-	-	-	1	-
		UME509.5	Evaluate the heat flow and select suitable welding technique for different applications	1	-	-	-	-	-	-	-	-	-	-	-	-	-
UME517	MATERIALS ENGINEERING & METALLURGY	UME517.1	develop and critically analyze the phase diagrams of isomorphous alloys, eutectic series alloys, and iron-carbon alloys	2	-	-	-	-	-	-	-	-	-	-	-	-	-
		UME517.2	describe phases/microstructures that exist in a given engineering material for analyzing its structure-mechanical property relationship	2	2	-	-	-	-	-	-	-	-	-	-	2	-
		UME517.3	obtain and interpret information from the TTT curves and CCT diagrams of different alloys.	-	-	-	2	-	-	-	-	-	2	-	-	-	-
		UME517.4	select and analyze suitable heat treatment/case hardening process for improvement in specific	2	2	-	-	-	-	-	-	-	-	-	-	-	1
		UME517.5	suitably select an advanced mechanical engineering material for a given industrial application	2	-	-	-	-	-	-	-	-	-	-	2	2	-
UME511	AUTOMOBILE ENGINEERING	UME511.1	evaluate the power requirement of a vehicle under different operating conditions.	3	-	-	-	-	-	-	-	-	-	-	1	-	-

		UME511.2	calculate the energy losses and define the design parameters in different vehicle components	3	-	-	-	-	2	2	-	-	-	-	-	-	-
		UME511.3	solve the technical issues related to vehicle design and malfunctioning of different components through fault-diagnosis and troubleshooting exercises of real case studies performed at the vehicle service stations.	3	-	-	-	-	2	3	-	-	-	-	3	1	2
UME700	GROUP PROJECT	UME700.1	Identify a problem based on the need analysis of community /industry/ research	-	3	-	-	-	2	-	-	2	-	-	-	-	-
		UME700.2	Create a flowchart of methodology for solving the identified problem	-	-	3	-	-	-	-	-	2	-	-	-	2	-
		UME700.3	Demonstrate team work with work division, team meetings and communications among team members	-	-	-	-	-	-	-	-	3	2	-	-	-	-
		UME700.4	Write technical report for the project work and present the same through power point presentations or posters	-	-	-	-	-	-	-	-	2	3	-	-	-	-
UPE602	SUPPLY CHAIN MANAGEMENT	UPE602.1	explore opportunities for cost reduction through Supply Chain efficiency,	-	-	-	3	-	-	-	-	-	-	3	-	-	-
		UPE602.2	assess demand versus supply and use it for aggregate planning	3	3	-	-	-	-	-	-	-	-	-	-	-	-
		UPE602.3	optimize product availability to improve revenue streams	-	-	-	-	-	-	-	-	-	-	3	-	-	-
		UPE602.4	assess performance of a supply chain – up stream as well as down stream	-	-	-	-	3	-	-	-	-	-	3	-	-	-
		UPE602.5	assess vulnerability in supply chains	-	-	-	3	-	-	-	-	-	-	-	-	3	-
UPE601	FACILITY PLANNING	UPE601.1	Classsify the characterstic features and production structures of different layouts	-	3	2	2	2	-	-	-	2	-	2	2	2	-
		UPE601.2	Analyse an existing facility in context to its location and design	-	-	2	2	3	-	-	-	2	-	-	-	2	-

		UPE601.3	Develop a new plant layout or to improve an existing layout	-	-	2	2	2	-	-	-	2	-	-	-	-	2
		UPE601.4	Design/re-design proposed a new material handling system	-	-	-	2	2	-	-	-	-	-	-	-	2	-
UME699	PROJECT SEMESTER	UME699.1	collect the relevant information to identify the problems and formulate the 'Problem definition'.	3	3	-	-	-	-	-	-	-	-	-	-	-	-
		UME699.2	analyze the problem with appropriate model to formulate solution using established research methods and review of literature.	-	-	-	3	-	-	-	-	-	-	-	-	-	-
		UME699.3	design or formulate the solution as per problem definition for solving the problem as per need or requirements.	-	-	3	-	-	-	-	-	-	-	-	-	-	-
		UME699.4	prepare a project report in specified format and grammar using proper citations and deliver the verbal presentation with the associated questionnaires.	-	-	-	-	-	-	-	-	-	3	-	-	-	-
		UME699.5	involve in assigned job by adopting new work environments in context of technology developments.	-	-	-	-	-	-	-	-	-	-	3	3	-	-
UME707	MACHINE DESIGN-II	UME707.1	select the suitable materials and identification of the manufacturing methods.	2	2	2	-	-	-	-	-	-	-	-	-	-	-
		UME707.2	design and analyze failure of gears for different loading conditions.	3	2	3	-	-	-	-	-	-	-	-	-	2	2
		UME707.3	select bearings for a given load carrying capacity	2	2	2	-	-	-	-	-	-	-	-	-	-	-
		UME707.4	apply different theories for designing friction clutch and brakes.	3	2	1	-	-	-	-	-	-	-	-	-	2	-
		UME707.5	design and analyze the real engineering system through design assignment.	3	3	2	-	-	-	-	-	3	2	-	-	3	2
		UME707.6	assemble, disassemble and generate the detail drawings of the existing or new mechanical system/subsystem	3	1	1	-	-	-	-	-	3	2	-	-	2	2

UME720	HEAT TRANSFER	UME720.1	apply the principles of conduction, convention and radiation mode of heat transfer to solve heat transfer problems.	3	3	-	1	1	-	-	-	-	-	-	-	-	-
		UME720.2	calibrate equipment, acquire, tabulate and analyze useful data in the laboratory, checks for repeatability and reproducibility.	3	3	1	3	1	-	-	-	-	1	-	-	-	2
		UME720.3	evaluate the thermal performance of heat exchangers and analyze and recognize their requirements of heat transfer optimization and pressure drop minimization.	3	3	1	1	1	-	-	-	-	3	-	-	-	2
		UME720.4	assess and evaluate the thermal performance of systems for radiation heat transfer and its applications.	3	3	1	-	-	-	-	-	-	3	-	-	-	-
UME719	REFRIGERATION AND AIR CONDITIONING	UME719.1	determine the COP for different types of air refrigeration systems	2	1	1	-	2	3	-	1	-	-	-	2	2	-
		UME719.2	determine the COP for vapour compression systems and heat pump	3	1	2	-	2	3	-	1	-	-	-	2	2	-
		UME719.3	perform thermodynamic analysis of absorption refrigeration systems and steam jet refrigeration	2	1	1	-	2	2	-	1	-	-	-	1	2	-
		UME719.4	perform the load calculations for the different type of air conditioning systems	3	1	2	-	2	2	-	1	-	-	-	3	2	-
		UME719.5	identify and determine the heating and cooling loads for air conditioning systems involving	3	1	2	-	2	3	-	1	-	-	-	3	2	-
UHU005	HUMANITIES FOR ENGINEERS	UHU005.1	Improve the understanding of human behavior with the help of interplay of professional, psychological and economic activities.	-	-	-	-	-	-	-	-	2	-	2	-	-	-
		UHU005.2	Able to apply the knowledge of basic principles of psychology, economics and ethics for the solution of engineering problems.	-	-	-	-	-	2	-	3	-	-	-	-	-	-
		UHU005.3	Explain the impact of contemporary issues in psychology, economics and ethical principles on engineering.	-	-	-	-	-	2	-	-	-	2	-	-	-	-

UME723	FLUID MACHINES	UME723.1	Derive and apply thermodynamic and fluid terminology to fluid machines	3	2	-	-	-	-	-	-	-	-	-	-	-	-
		UME723.2	Determine the parameters affecting performance pumps and turbine	3	2	-	-	-	-	-	-	-	-	-	-	-	-
		UME723.3	Draw the velocity triangles in turbo machinery stages operating at design and offdesign conditions	3	-	-	-	-	-	-	-	-	-	-	-	-	-
		UME723.4	Determine methods to analyze flow behavior depending upon nature of working fluid and geometric configuration of fluid machinery	3	-	-	-	-	-	-	-	-	-	-	-	-	-
UME513	DYNAMICS AND VIBRATIONS	UME513.1	apply engineering principle of mechanics to design motion transmission devices and flywheels	3	2	-	-	-	-	-	-	-	-	-	-	-	-
		UME513.2	determine the appropriate parameters for stability of a vehicle using the concept of gyroscopic action	3	2	-	-	-	-	-	-	-	-	-	-	-	-
		UME513.3	derive the dynamic model of real-life problems and verify the natural frequencies and mode shapes	3	3	-	-	-	-	-	-	-	-	-	-	2	-
		UME513.4	analyze two- and multi-DOF physical systems analytically and validate using a commercial package	3	2	-	-	2	-	-	-	2	-	-	1	2	2
UME793	CAPSTONE PROJECT	UME793.1	identify a need of society/industry at large and formulate it into a specific engineering design problem	-	1	-	-	2	3	2	0	2	3	1	-	-	-
		UME793.2	design a mechanical system implementing an integrated system design approach applying knowledge accrued in various professional courses	3	3	2	-	2	1	2	2	2	2	-	3	3	3
		UME793.3	recognize the importance of engineering design solutions with consideration ofsafety, economic, environmental and societal factors	3	2	3	-	-	3	3	2	-	-	-	1	1	1

		UME793.4	evaluate and analyze the design considering various requirements like reliability, design optimality, manufacturing and assembly feasibility, ease of installation and maintenance, etc using applicable design / industry standards	3	3	2	2	3	1	2	2	-	-	-	2	2	2
		UME793.5	create production drawings for mechanical components and systems following relevant standards and conventions	2	-	-	-	3	-	-	-	-	3	-	-	1	1
		UME793.6	use suitable manufacturing/fabrication techniques to produce components and/or simulation tools to analyse the working/performance of the designed product/system	2	-	-	3	3	1	1	1	2	2	3	2	2	3
		UME793.7	demonstrate team work by actively participating/contributing in the group project work	-	-	-	-	-	-	-	2	3	3	2	2	-	-
		UME793.8	communicate effectively with a range of audiences including peers	-	-	-	-	2	-	-	-	2	3	2	2	-	-
UME518	INTRODUCTION TO ROBOTICS	UME518.1	Develop the Forward-Kinematic model/arm equation and algorithmic scheme for finding the solution for the inverse kinematics of a given serial robotic manipulator	3	2	-	-	1	-	-	-	-	-	-	1	2	-
		UME518.2	Design and analyze a robotic manipulator or develop specifications of a robotic device required for planned application/s considering its integration with other work cell devices.	-	-	2	-	-	-	-	-	-	-	-	-	-	2
		UME518.3	Develop and analyze the mathematical model for a robotic controller considering trajectory planning and resolved motion rate control for a given robotic manipulator.	3	2	-	-	-	-	-	-	-	-	-	-	2	-

		UME518.4	Design and implement motion planning and navigation algorithms for a mobile robotic device	3	-	2	-	-	-	-	-	-	-	-	1	2	-
UME525	VEHICLE DYNAMICS	UME525.1	characterize the behaviour of vehicle systems and subsystems	3	2	-	-	-	1	-	-	-	-	-	1	2	-
		UME525.2	develop computer models of linkages and complete working assemblies in two and three dimensions.	-	2	2	-	-	-	-	-	-	-	-	-	-	2
		UME525.3	develop models of vehicles for analysis of kinematics, (velocities and accelerations), kinetics (forces and moments).	-	2	-	-	-	-	-	-	-	-	-	-	2	-
		UME525.4	perform simulations of rigid multi-body assemblies and calculation of loads, dynamic forces, energy and momentum in two and three dimensions.	-	2	-	-	3	-	-	-	2	-	-	1	-	2
UME524	ADDITIVE MANUFACTURING	UME524.1	Implement the concepts of transformation and solid modeling in developing a solid model.	2	1	3	-	3	-	-	-	1	-	-	2	2	2
		UME524.2	Examine & detect the errors in .stl files and implement a suitable repair algorithm.	2	3	3	-	-	-	-	-	1	-	-	2	2	2
		UME524.3	Identify suitable process and process parameters required for fabricating a part through additive manufacturing.	2	3	3	2	3	-	-	-	1	-	-	2	2	2
		UME524.4	Evaluate the effect of slicing methods, design of support structures, and part deposition orientation on volumetric shrinkage and accuracy of the developed parts.	2	3	2	2	3	-	-	-	1	-	-	2	2	2
UME839	RENEWABLE ENERGY SYSTEMS	UME839.1	Calculate the terrestrial solar radiation on an arbitrary tilted surface.	2	2	1	2	-	-	-	-	-	-	-	-	2	1
		UME839.2	Use flat-plate solar collector mathematical model to calculate the efficiency and performance parameters of the same.	2	3	2	2	-	-	-	-	-	-	-	-	2	2

		UME839.3	determine the plant efficiency of geothermal plant	2	2	2	1	-	-	-	-	-	-	-	-	2	1
		UME839.4	select factors that are required to consider when selecting sites for tapping renewable energy.	1	3	1	1	-	-	-	-	-	-	-	-	1	2
		UME839.5	determine maximum efficiency and maximum obtainable power from a given wind turbine.	3	2	2	1	-	-	-	-	-	-	-	-	2	2
UPE705	COMPUTER AIDED MANUFACTURING	UPE705.1	create a plan for machining of a given part on a multi-axis CNC machining center including selection of machining parameters, cutting tools, process sequence and controller settings for tool presets.	3	3	3	3	3	-	2	-	2	2	-	3	3	3
		UPE705.1	create and validate a CNC part program data using manual data input (MDI) / commercial CAM package for machining of component using a CNC machining centre.	3	3	3	3	3	-	2	-	2	2	-	3	3	3
		UPE705.1	Analyse and apply the appropriate automated manufacturing support system.	3	3	3	3	3	-	2	-	2	2	-	3	3	3
UME737	CONDITION MONITORING OF ROTATING MACHINES	UME737.1	evaluate data sources and data quality in the context of rotating machinery faults	3	3	2	-	-	-	-	-	-	-	-	-	2	2
		UME737.2	work in groups to demonstrate proficiency at use of analytical tools and justify the use of methods selected	3	2	-	-	2	-	-	-	2	-	-	-	1	-
		UME737.3	use data and analytical tools to make predictive diagnosis regarding data from actual faults from rotating machinery equipment.	2	2	1	-	2	-	-	-	-	-	-	-	2	2
UME722	SYSTEM MODELLING AND SIMULATION	UME722.1	frame bond graph models of systems using power variables, reference power directions, causality.	3	3	-	-	-	-	-	-	-	-	-	-	3	3
		UME722.2	generate the system equations from bond graph models.	3	3	-	-	-	-	-	-	-	-	-	-	3	3
		UME722.3	develop bond graph models of structural/thermal systems	3	3	-	-	-	-	-	-	-	-	-	-	3	3

		UME722.4	create different control systems and stability analysis using bond graph.	3	3	-	-	-	-	-	-	-	-	-	-	3	3
UME857	ADVANCED MECHANICAL VIBRATION	UME857.1	Ability to define, formulate and solve advanced problems of mechanical vibrations	3	3	2	-	-	-	-	-	-	-	-	-	2	-
		UME857.2	Being able to provide information about determining Natural Frequencies and Mode shapes	3	3	2	-	2	-	-	-	-	-	-	-	3	2
		UME857.3	Being able to provide information about determining forced response	3	2	2	-	-	-	-	-	-	-	-	-	2	-
UME841	MODERN AUTOMOBILE ENGINEERING	UME841.1	understand the function of electronic systems in modern automobiles.	-	-	-	-	3	2	-	-	-	-	-	3	3	2
		UME841.2	evaluate the use of modern electronics technology to improve the performance, safety, comfort and related issues.	-	-	-	-	3	3	-	-	-	-	-	3	3	2
		UME841.3	synthesize and specify the addition of new features in existing electronic automotive subsystems for enhanced functionality.	-	-	-	-	3	3	-	-	-	-	-	3	3	2
UME856	TOTAL QUALITY MANAGEMENT	UME856.1	analyze various obvious and hidden quality costs of a firm for quality system economics	-	-	3	3	-	-	-	-	-	-	-	-	-	-
		UME856.2	apply various quality control tools for troubleshooting to reduce sporadic quality problems	3	-	-	3	-	-	-	-	-	-	3	-	-	-
		UME856.3	conduct process capability analysis	-	3	-	2	-	-	-	-	-	-	2	-	-	-
		UME856.4	perform line and angular measurements using appropriate metrological instruments	-	3	-	-	-	-	-	-	-	-	-	-	-	-
UPE703	METAL FORMING	UPE703.1	Decide yielding of a material according to different yield theory for a given state of stress	3	2	-	-	-	-	-	-	-	-	-	-	1	1
		UPE703.2	analyze the different bulk metal forming process mechanics using different analysis approach and	3	2	-	-	-	-	-	-	3	-	-	-	1	-

			calculate the force, power requirements etc.															
		UPE703.3	Calculate the die and punch sizes for different sheet metal operations and to calculate the required load for the process	2	-	3	-	-	-	-	-	-	-	-	1	-	1
		UPE703.4	Evaluate the effect of process parameters on the process mechanics during bulk metal forming.	3	2	-	2	-	-	-	-	2	-	-	-	-	-
UME836	OPERATIONS MANAGEMENT	UME836.1	analyze the fundamental theory of operations and production management	1	-	-	-	-	-	-	-	-	-	-	-	-	-
		UME836.2	analyze forecasting problems or issues faced by service and manufacturing industries	2	-	-	-	2	-	-	-	2	-	-	-	-	-
		UME836.3	solve problems on materials requirement planning, aggregate production planning	2	-	-	-	2	-	-	-	2	-	-	-	-	-
		UME836.4	analyze inventory management problems	-	-	-	-	1	-	-	-	-	-	-	-	-	-
UPE503	LEAN AND AGILE MANUFACTURING	UPE503.1	Apply the procedure of manufacturing management to prepare aggregate plans and schedules for manufacturing systems	3	-	-	-	-	-	-	-	-	-	-	-	-	-
		UPE503.2	Evaluate the set up changeover procedures, identify areas of improvement and improve them	2	-	-	-	-	-	-	-	-	-	-	-	-	-
		UPE503.3	Apply the concept, principles and techniques of lean manufacturing to reduce waste and improve productivity of manufacturing systems	3	2	1	1	3	-	2	-	-	-	-	-	2	2
		UPE503.4	Evaluate agility in manufacturing systems, identify areas of improvement and develop action plans	2	2	1	1	-	-	-	-	-	-	-	-	-	2

		UPE503.5	Apply the concept, structure and essentials of Industry 4.0 to improve processes and their integration	3	3	3	3	3	-	-	-	-	2	-	-	2	3
UME831	COMPUTATIONAL FLUID DYNAMICS	UME831.1	Derive and analyse the various types of fluid flow governing equations	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
		UME831.2	Analyse the internal fluid flow phenomena of thermal and fluid system	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
		UME831.3	Simulate engineering problems using commercial CFD tools.	-	-	3	-	3	-	-	-	-	-	-	-	-	-	3
UME853	SOLAR ENERGY ENGINEERING	UME853.1	calculate incident solar irradiance (diffuse and direct components) on flat and inclined surfaces for a given geographical location	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
		UME853.2	identify optimum heat transfer fluids for solar energy utilization	2	-	-	-	-	-	2	-	-	-	-	-	-	-	-
		UME853.3	select solar selective materials and optimum geometric configurations for harnessing solar energy	2	-	-	-	-	-	2	-	-	-	-	-	-	-	-
		UME853.4	draw thermal resistance diagrams relevant to the constituent elements of a given solar thermal system	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
		UME853.5	evaluate the thermal and optical performance of PV and solar thermal systems	3	2	-	-	-	-	-	-	-	-	-	-	3	-	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) *"-" No correlation,*

1.2 Attainment of Course Outcomes

1.2.1 Describe the assessment tools and processes used to gather the data upon which the evaluation of Course Outcome is based

A. <u>Assessment Tools used for measurement of Course Outcome attainment:</u>

For each course offered to the students, COs are defined and mapped with Program Outcomes and Program Specific Outcomes. Assessment tools used for measuring the attainment of the course outcomes can be broadly classified into two categories viz. Direct Assessment tools and Indirect Assessment tools. Direct assessment tools primarily rely on the student's performance in formal/informal tests, whereas indirect assessment tools are broadly perception based.

1. **Direct Assessment:** The knowledge and skills learnt by the student are assessed directly from their performance through internal and external assessment processes.

   External assessment processes include the performance of student in the final / End semester examination. In the internal assessment, the performance of student is recorded through mid-semester tests, tutorials assignments, Project work/report, seminar work, laboratory assignments etc.,
   Table 1.2.1(a) shows the description of the direct assessment tools.

Table 1.2.1 (a): **Direct Assessment tools for Course Outcome Measurement**		
S. No.	**Direct Assessment Tool**	**Method Description**
1	End Semester Examination	The end Semester examination is a metric for assessing whether all the COs are attained or not. It focuses more on attainment of course outcomes and uses a descriptive and rigorous examination form. Marks obtained in End Semester Examination are the basis for recording the attainment of course outcomes. The attainment level is calculated based on the attainment criteria decided at the departmental level.
2	Mid Semester Examination	The mid-semester examination is a cumulative internal examination tool. The mid-semester examination is carried out during the middle of a semester, and it is an effective metric to continuously assess the attainment of course outcomes. The examination is focused on attaining the course outcomes.
3	Quiz	Quiz is a Cumulative Internal Examination tool. Quizzes are generally multiple-choice questions (MCQ) based examination systems that provide an easy-to-use environment for both test conductors and students appearing for examinations.

3	Tutorial/Assign ment	Tutorials are given in class tutorial periods where students solve problems based on topics learnt in class. Also, Students are given assignments to submit after the completion of each unit of the syllabus. Tutorial assignments are graded, and it helps teachers understand the level of understanding of students. The home assignment is a qualitative performance assessment tool designed to assess students' knowledge of engineering practices, frameworks, and problem-solving. An analytic rubric is developed and used to assess students' knowledge with respect to the learning outcomes.
4	Lab Assignment/ Performance	Lab Assignment is one of the measuring criteria to mainly assess students' practical knowledge with their designing capabilities. In the case of Practical, the assessment marks are based on the laboratory performance, records, viva/quiz etc.
5	Project Semester Evaluation	In the sixth semester, all students of the Mechanical Engineering Program are required to spend a full six month's semester in the industry completing an industrial project under the joint supervision of industry supervisors and TIET faculty. This provides a system of education that formally integrates academic studies with related work experience. Project works undertaken during training is evaluated in the 7th semester. 25% marks are awarded jointly by the faculty and industrial coordinator. Balance 75% marks are awarded based on the presentation and viva voice given by the student on the project work he/she underwent. The presentation is evaluated by the panel comprising a group of 5-7 faculty members of the department and headed by the senior faculty from the department.
6	Capstone Project work	It is a project-based course spread over two semesters (7^{th} and 8^{th} semester) to teach and implement an integrated approach to use electronic, mechanical, electromechanical, control and computer systems that contain software and hardware components, including sensors, actuators and controllers. In this course, students work in a group, and each group is required to design a mechatronic system involving problem definition, mechanism and component selection, analysis, synthesis, optimization, fabrication and report writing.The internal assessment marks for projects in the final year are based on individual and team performance during milestone evaluations and the final showcase event. The complete process of review and evaluation is done according to the guidelines set by the departmental project evaluation committee.

2. **Indirect Assessment (Course Exit Survey):** Indirect assessment for CO attainment in each course is accomplished by conducting a Course Exit Survey at the end of the semester. Such surveys aim to get formal feedback from students for the courses offered in a semester and provide objective information to the faculty for self-appraisal, self-improvement, and development. The course survey is focused on the attainment of course outcomes. It is mandatory for all students to participate in such surveys.

B. <u>Processes used for measurement of Course Outcome Attainment:</u>

1. Calculations of Course Outcome Attainment using Direct Assessment tools:

Course outcomes of any given course can be measured by using either

i. Semester End Examination (SEE), i.e., End Semester Examination

ii. Cumulative internal examination (CIE), which includes mid-semester test, Tutorial assignments, Lab evaluations, Project work or seminars etc.

Concerned course instructor/s decide the measurement tool/s to be employed for the measurement of CO attainment.

Threshold (cut-off) values for SEE and CIE based tools are set as follows:

i. 45% of the total marks for SEE based measurement tool

ii. 60% of the total marks for CIE based measurement tool

Course outcome attainment levels are determined by calculating the percent of students scoring more than or equal to the threshold (cut-off) values for the respective measurement tool (45% for SEE & 60% for CIE).

Attainment Levels are awarded on the basis of the following criteria.

Table 1.2.1 (b): **CO attainment criteria**			
SEE Based Measurement Tool		**CIE Based Measurement Tool**	
% of students	**CO Attainment level**	**% of students**	**CO Attainment level**
<30%	Level-0	<30%	Level-0
≥30%	Level-1	≥30%	Level-1
≥50%	Level-2	≥50%	Level-2
≥75%	Level-3	≥75%	Level-3

2. Calculations of Course Outcome Attainment using Indirect Assessment tools:

At the end of the semester, an online student survey is conducted, wherein students are requested to provide feedback on the level of their abilities related to the laid-out course outcomes. It is mandatory for all students to provide this online feedback.

Following is the sample of such a course exit survey form, which each student is required to fill at the completion of a course.

Table 1.2.1 (c): Sample Course Exit Survey Form for Measuring Indirect CO attainment

The undergraduate program in Mechanical Engineering has been designed with certain course outcomes, where each course outcome describes what students are expected to know and be able to do after undertaking the course.

Each student is requested to actively participate and answer the following questionnaire to assess how well he/she has attained the course outcomes set for each course.

Please answer the questionnaire on a scale of 1 to 5 where 1 indicates little achievement or skill, and 5 indicates a great deal of achievement.

Mechanics of Machines (UME308)						
Survey questionnaire		**Level of attainment on an assessment scale of 1 to 5**				
I achieved the ability to		1	2	3	4	5
1						
2						
3						
4						

The indirect attainment level of a course outcome is obtained by averaging the student feedback score in the course exit survey for each course outcome. The indirect CO scores measured through this tool are mapped to a Likert scale of 1 to 3.

However, in the cycles 2020-21, and 2021-22, due to the COVID situation, the of measurement of some of the Course Outcome attainment through Indirect tools (Student Surveys) could not be done.

3. Overall Course Outcome Attainment:

Overall Course Outcome attainment level is calculated by considering the weightage of 80% for direct assessment and 20% for indirect assessment.

1.2.2 Record the attainment of Course Outcomes of all courses with respect to set attainment levels

Details for Course Outcome Measurement for UME308 (Mechanics of Machines) are shown below in Tables B.1.2.2 (a)-(f) for reference purpose. Table 1.2.2. (a) shows measurement tools used, marks and the corresponding threshold (cut-off) values for Course outcomes for course number UME308 (Mechanics of Machines).

Table 1.2.2 (a): **Course Outcome Measurement for UME308 (Mechanics of Machines).**

CO #	CO Statement	Measurement Tool Employed	Marks	Threshold Value
UME308.1	Analyse a set of mechanisms to achieve desired motion transformation.	EST Q1(a)	6	**2.4**
UME308.2	Apply analytical methods for the evaluation of velocity and acceleration of mechanisms.	MST Q3	7	**3.5**
UME308.3	Analyse and construct cam profiles for different motion of follower.	EST Q1(b)	8	**3.2**
UME308.4	Evaluate the unbalance in rotating/reciprocating systems and carry out their balancing.	EST Q2(a)	9	**3.6**
UME308.5	Formulate equations of motion, evaluate the responses of different real-life vibration	EST Q4(b)	8	**3.2**

Table 1.2.2 (b) shows the performance of students enrolled for UME308 course during session 2022-23.

Table 1.2.2 (b): Performance of Students in various CO measurement tools (UME308)

S. No.	Roll no.	Name	CO1 UME308.1	CO2 UME308.2	CO3. UME308.3	CO4 UME308.4	CO5 UME308.4
1.	102108001	Jaswinder Chopra	5	5	8	5	1
2.	102108002	Rishit Johar	6	4	8	4	0
3.	102108004	Arush Anand	6	4	4	3.5	4
4.	102108005	Arpit Singh	4	3	6	1	1
5.	102108007	Prabhjot Singh	3	NA	3	0	0
6.	102108008	Japagam Singh Arora	4	NA	8	9	0
7.	102108010	Dhruva Sharma	NA	3	NA	NA	NA
8.	102108011	Anugya Sharma	1	2	4	3.5	8
9.	102108012	Abhijeet Singh	5	5	8	9	0
10.	102108014	Yash Kapoor	5	4	6.5	6	4
11.	102108015	Anusha Kumari	5	5	8	9	8

12.	102108016	Tejansh Garg	NA	2	NA	NA	NA
13.	102108017	Harshit Barhay	NA	NA	NA	NA	NA
14.	102108018	Pratyush Proach	4	3	6.5	6	1
15.	102108019	Arkansh Sharma	6	6	8	4.5	0
16.	102108020	Lakshya Raj Singh	5	3	5	9	0
17.	102108021	Rachit Budhiraja	6	4	8	8	3
18.	102108022	Rahul Aggarwal	2	NA	3	5	5.5
19.	102108025	Abhay Gupta	6	4	6.5	8	4
20.	102108026	Rudrav Chatterjee	6	4	6	4.5	0
21.	102108027	Arihan Singh	0	2	5	6	0
22.	102108028	Tanmay Wasson	3	6	8	7	2
23.	102108029	Rajanvir Singh Lehal	4	2	0	0	0
24.	102108031	Ekansh Bharti	NA	NA	NA	NA	NA
25.	102108032	Utkarsh Guleria	6	5	7	6	4
26.	102108033	Aayush Kumar Singh	4	1	3	4	0
27.	102108034	Aditya Sharma	0	3	4	0	0
28.	102108035	Kshitij Kumar Chhabariya	4	4	8	9	5
29.	102108036	Bowneet Pal Singh	1	NA	8	2.5	0
30.	102108037	Saumay Ahuja	6	5	6.5	9	7
31.	102108041	Kanishka Jain	2	NA	7	4	2
32.	102108045	Hriday Sharma	3	4	4	9	0
33.	102108046	Vikas Bahl	4.5	3	6.5	4	1
34.	102108047	Ekasjot Singh Sahi	4.5	NA	8	2.5	8
35.	102108048	Seharkiran Kaur	0	3	8	0	8
36.	102108049	Manmeet Kaur	6	5	6	9	5
37.	102108050	Gangesh	0	2	0	0	0
38.	102108051	Harkirath Singh Jolly	6	4	8	3.5	7
39.	102108053	Ishtiyaq Ali Pandith	3.5	5	2	1	0
40.	102108054	Ekamveer Singh	6	4	6.5	9	3
41.	102108055	Tanvansh Singh	5	4	6.5	9	0
42.	102108056	Jaspreet Singh	6	3	3	4	3
43.	102108058	Shashwat Prakash	3	4	6.5	3.5	0
44.	102108059	Ujjal Deep Singh Jhajj	5	4	4	5	0
45.	102108060	Taranpreet Singh	4.5	3	6.5	4	1
46.	102108061	Devansh Chaudhary	2	2	2.5	6	0
47.	102108062	Pratham Kapoor	NA	4	NA	NA	NA
48.	102108065	Swarnim Dhankher	6	5	8	9	3
49.	102108067	Gurpreet Singh	4.5	2	4	4.5	0
50.	102108068	Adetya Sharma	3	5	3	7	4
51.	102108069	Mudit	4.5	4	8	3.5	8
52.	102108070	Kawin Sharma	6	4	3	9	8
53.	102108071	Rhythm Garg	5	3	6	5	2
54.	102108073	Kommineni Sai Krishna	4	6	8	9	8
55.	102108074	Aditya Ralhan	2	2	3	1.5	0

56.	102108076	Arsh Raaj Bhatnagar	2	3	0	7	8
57.	102108079	Jashanvir Singh Toor	6	5	7	6	2
58.	102108080	Aviraj Singh Nannar	4	4	6	4	0
59.	102108081	Pranav Bansal	6	4	8	9	4
60.	102108082	Udai Singh Bhaati	0	0	7	7	0
61.	102108083	Kanishk Rajput	4	6	7	8	8
62.	102108084	Nakul Goyal	4	5	5	7	8
63.	102108086	Mrinal Choudhary	3	4	4	4	6
64.	102108087	Aviansh Malhotra	5	0	8	3	2
65.	102108088	Vishal Singh	6	5	7	9	2
66.	102108089	Jimmy Saklani	6	5	8	7	6
67.	102108093	Menthe Jeevan Prakash	6	4	2	7	3
68.	102108094	Manas Thakur	0	4	4	7	2
69.	102108095	Sitanshu Kaloti	0	4	4	3.5	1
70.	102108099	Harmandeep Singh	6	4	7	9	8
71.	102108107	Akshat Thakur	6	3	7	5	8
72.	102108109	Sumer Pratap Singh	4.5	NA	6	4.5	0
73.	102108110	Ansh Gupta	1	5	8	3	1
74.	102108131	Swati Garg	4.5	4	4	4	5
75.	102108169	Yagyesh Saraswat	1	5	8	2	0
76.	102108199	Amritansh Yadav	4	2	3	5	0
77.	102108208	Vrinda Gulati	6	4	8	5	3
78.	102108213	Harshit Negi	2	NA	3	4	4
79.	102108226	Harshveer Singh	4.5	2	6	4	1
80.	102288001	Saharsh Mundhra	6	6	4	5	6
81.	102288002	Antrix Chadha	3	4	6.5	3	4
82.	102288003	Jashanpreet Singh	3	4	8	6	1
83.	102288004	Pragam Verma	3.5	1	6.5	9	7
84.	102288005	Aryan	2	NA	4	3.5	2
85.	102288006	Eshan Gupta	NA	NA	NA	NA	NA
86.	102288007	Karanvir Gill	3	NA	2	3.5	1
87.	102288008	Manpreet Singh	4.5	NA	6	4	3
88.	102288010	Vaibhav Kapoor	5	NA	5	9	8
89.	102288011	Ishant Chandel	6	2	8	5	2
90.	102288012	Pritam Singh	3.5	NA	7	5	1
91.	102108038	Kanishk Mehta	0	4	0	6	0
92.	102108039	Hiten Bansal	4	1	8	3.5	8
93.	102108090	Vanshaj Singh	6	2	3	7	0
94.	102108096	Tanisha Arora	4	4	8	3.5	4
95.	102108103	Pranav Mittal	5	4	4	7	6
96.	102108104	Anant Agarwal	6	2	4	7	4
97.	102108105	Kunal Uppal	6	NA	0	8	0
98.	102108108	Soumil Mahajan	4.5	NA	0	2	4
99.	102108111	Yash Karol	6	2	8	9	0
100.	102108112	Mahi Vats	5	3	8	5	4

101.	102108113	Suryansh	2.5	NA	7	5	0
102.	102108114	Samanvay Gaur	4.5	6	8	4	8
103.	102108115	Harshil Tripathi	3.5	4	8	2.5	2
104.	102108116	Ansh Jindal	NA	1	NA	NA	NA
105.	102108117	Dhruv Maheshwari	4.5	3	6.5	7	2
106.	102108118	Mudit Rawal	4.5	4	3	2.5	0
107.	102108119	Nitya Gupta	6	5	8	4.5	8
108.	102108120	Prabhav Pathania	1	4	8	2	1
109.	102108121	Shreya Sejal	5	6	8	1.5	0
110.	102108122	Bikash Kumar Mahato	3.5	5	4	3	0
111.	102108123	Shivam Verma	6	3	4	9	2
112.	102108124	Jasminder Singh	6	5	7	9	0
113.	102108125	Dhruva Verma	2	NA	1	3	0
114.	102108126	Tavish Bansal	5	2	8	3.5	7
115.	102108127	Manav Sharma	5	6	1	6	4
116.	102108128	Aditya Agarwal	5.5	3	8	5	0
117.	102108129	Amitoj Singh	3	4	2	3.5	0
118.	102108130	Harpuneet Singh	5	NA	8	3.5	1
119.	102108132	Shivangi Srivastava	3.5	3	8	3.5	1
120.	102108133	Eshaan Dev Raj	0	NA	3	8	4
121.	102108135	Aditya Sehgal	2.5	0	8	3	1
122.	102108136	Mohit Apoorva Singh	2.5	2	4	2.5	1
123.	102108137	Kartik Arora	6	5	6.5	7	8
124.	102108139	Sourav Kumar	6	3	3	4	7
125.	102108140	Aadil Singh	6	4	8	8	1
126.	102108141	Mridul Gupta	0	2	0	3	0
127.	102108142	Naman Jain	3.5	NA	4	2.5	4
128.	102108143	Aksh Singhal	3	4	7	6	0
129.	102108144	Piyush Dhawan	2.5	2	0	2	6
130.	102108146	Arnav Budhiraja	4	3	2	2.5	0
131.	102108148	Shikhar Chaudhary	0	3	2	5	3
132.	102108149	Anushree Verma	0	2	6	3	1.5
133.	102108150	Devit Rattan	4	NA	8	2.5	1
134.	102108151	Samyak Kumar Mishra	4.5	2	1	7	0
135.	102108152	Anish Behera	2	4	3	2.5	6
136.	102108154	Ansh Singh	2	5	4	5	3
137.	102108155	Aditya Dev M	0	1	8	4	2
138.	102108156	Gautam Malik	4.5	6	8	9	8
139.	102108157	Gurkirat Singh	4	4	8	5	4
140.	102108158	Japteshwar Singh	4	5	6	4.5	4
141.	102108159	Chirag Goyal	3	4	8	3	8
142.	102108161	Gursimran Kaur	3	3	3	3	8
143.	102108163	Priyanshu Mishra	NA	NA	NA	NA	NA
144.	102108164	Milanpreet Singh	0	4	4	9	8

		Chadha					
145.	102108165	Yuvraj Singh	6	6	4	9	8
146.	102108166	Abhinav	6	4	8	7	3
147.	102108171	Ali Hamza	6	5	8	7	0
148.	102108172	Aayan Zaidi	3	6	2	0	0.5
149.	102108173	Aditya Ratan Jain	6	5	8	9	5
150.	102108174	Aaditya Goyal	6	4	8	9	5
151.	102108175	Kirtvir Singh	6	6	4	9	1
152.	102108176	Ansh Gupta	6	3	8	9	4
153.	102108177	Swapnil Choudhary	2.5	NA	4	2.5	3
154.	102108178	Eetash Kaul	4	NA	5.5	2.5	4
155.	102108179	Anshul Wahee	5	4	6	9	0
156.	102108180	Madhav Garg	2	2	0	6	3
157.	102108181	Rohit Singla	6	3	4	8	5
158.	102108183	Vigyan Lal	6	4	4	4	8
159.	102108184	Shivam Singh	6	NA	0	5	4
160.	102108186	Nilesh Arora	2	4	0	6.5	6
161.	102108188	Rachanbir Singh Biding	6	3	6	9	1
162.	102108189	Kudrat Kaur Sandhu	5	5	3	4	1
163.	102108190	Achyut Sharma	6	NA	7	9	0
164.	102108191	Aman Seth	4	NA	5	5	1
165.	102108195	Shree Krishna Atri	0	5	5	5	2
166.	102108196	Aman	6	6	8	9	6
167.	102108200	Nitin Chaudhary	6	6	8	4	8
168.	102108201	Tanisha	3	5	6	7	0
169.	102108202	Rahul Rawat	6	3	7	4	0
170.	102108203	Yash Vardhan	6	5	3	4	3
171.	102108204	Sagar Mavi	6	2	6	0	8
172.	102108207	Debojyoti Barman	5	4	8	4	2
173.	102108211	Gurriday Singh Chawla	6	2	4	4	0
174.	102108212	Diya Trivedi	3	NA	0	0	0
175.	102108214	Viral Vatsal	4	4	4	0	3
176.	102108215	Avdhesh Tuli	4	2	3	3.5	6
177.	102108216	Deshmukh Mandar Manish	2	6	8	4.5	8
178.	102108217	Eshan Sharma	5	NA	3	6	8
179.	102108218	Prattush Jain	6	7	8	4	1
180.	102108219	Harsh Rayal	3	4	6	2.5	3
181.	102108221	Nidhi Singh	4.5	2	0	9	2
182.	102108223	Harsh Mishra	3.5	NA	8	9	4
183.	102108227	Arshveer Singh	0.5	0	4	2	0
184.	102288013	Vansh Gautam	6	3	4	4	4
185.	102108228	Shubhashish Sharma	3.5	1	4	4	6
Count of student above the set threshold value			**177**	**152**	**177**	**177**	**177**

Table 1.2.2 (c) shows the CO attainment level for UME308 using direct assessment tool as per defined attainment criteria.

***Table 1.2.2 (c):* Assigning Course Outcome Attainment level (Direct Assessment) for UME308**				
Course Outcome	**Threshold Value**	**No. of Students above Threshold Value**	**% Students above Threshold Value**	**CO Attainment Level**
UME308.1	2.4	143	$\frac{143}{177} \times 100 = 80.8\%$	3
UME308.2	3.5	91	$\frac{91}{152} \times 100 = 59.9\%$	2
UME308.3	3.2	134	$\frac{123}{177} \times 100 = 75.7\%$	3
UME308.4	3.6	122	$\frac{122}{177} \times 100 = 68.9\%$	2
UME308.5	3.2	71	$\frac{71}{177} \times 100 = 40.1\%$	1

Table 1.2.2 (d) below shows the indirect Course Outcome attainment for UME308 based on course exit survey.

***Table 1.2.2 (d) :* Indirect CO attainment through Course Exit Survey for UME308**	
Course Outcome	**Indirect CO Attainment based on course exit survey**
UME308.1	2.658
UME308.2	2.658
UME308.3	2.628
UME308.4	2.658
UME308.5	2.574

Table 1.2.2 (e) shows overall course outcome computations using direct and indirect scores for UME308.

***Table 1.2.2 (e) : :* Computation of Overall Course Outcome Attainment for UME308**			
Course Outcome	**Direct CO Attainment**	**Indirect CO Attainment**	**Overall CO Attainment (80% Direct + 20% Indirect)**
UME308.1	3	2.658	2.9316
UME308.2	2	2.658	2.1316
UME308.3	3	2.628	2.9256
UME308.4	2	2.658	2.1316
UME308.5	1	2.574	1.3148
OVERALL CO attainment for UME308			**2.287**

Similarly, the overall course outcomes for all courses offered during 2022-23 session have been computed using direct and indirect attainment scores as shown in Table 1.2.2 (f).

Table 1.2.2 (f): **ATTAINMENT OF COs OF COURSES (2022-23 Session)**								
COURSE No.	**COURSE NAME**	**CLO NO.**	**CLOs STATEMENT**	**DIRECT**	**INDIRECT**	**Direct Attainment**	**Indirect Attainment**	**Average CO Attainment at Course level**
UEC001	ELECTRONIC ENGINEERING	UEC001.1	Demonstrate the use of semiconductor diodes in various applications.	3	3	2.60	3.00	2.68
		UEC001.2	Discuss and explain the working of transistors and operational Amplifiers, their configurations and applications.	3	3			
		UEC001.3	Recognize and apply the number systems and Boolean algebra.	2	3			
		UEC001.4	Reduce Boolean expressions and implement them with Logic Gates.	3	3			
		UEC001.5	Analyze, design and implement combinational and sequential circuits.	2	-			
UHU003	PROFESSIONAL COMMUNICATION	UHU003.1	Apply communication concepts for effective interpersonal communication.	2	-	2.60	NA	2.60
		UHU003.2	Select the most appropriate media of communication for a given situation.	3	-			
		UHU003.3	Speak assertively and effectively.	2	-			
		UHU003.4	Write objective organizational correspondence.	3	-			
		UHU003.5	Design effective resumes, reports and proposals.	3	-			

UMA010	MATHEMATICS – I	UMA010.1	examine functions of several variables, define and compute partial derivatives, directional derivatives and their use in finding maxima and minima in some engineering problems.	3	-	2.25	NA	2.25
		UMA010.2	evaluate multiple integrals in Cartesian and Polar coordinates, and their applications to engineering problems.	2	-			
		UMA010.3	determine the convergence/divergence of infinite series, approximation of functions using power and Taylor's series expansion and error estimation.	2	-			
		UMA010.4	represent complex numbers in Cartesian and Polar forms and test the analyticity of complex functions by using Cauchy-Riemann equations.	2	-			
UPH004	APPLIED PHYSICS	UPH004.1	Understand damped and simple harmonic motion, the role of reverberation in designing a hall and generation and detection of ultrasonic waves.	2	-	1.60	NA	1.60
		UPH004.2	Use Maxwell's equations to describe propagation of EM waves in a medium.	1	-			
		UPH004.3	Demonstrate interference, diffraction and polarization of light.	1	-			
		UPH004.4	Explain the working principle of Lasers.	2	-			
		UPH004.5	Use the concept of wave function to find probability of a particle confined in a box.	2	-			

UTA015	ENGINEERING DRAWING	UTA015.1	creatively comprehend the geometrical details of common engineering objects	3	-	2.40	NA	2.40
		UTA015.2	draw dimensioned orthographic and isometric projections of simple engineering objects	3	-			
		UTA015.3	interpret the meaning and intent of limits, fits and tolerances in the drawing	0	-			
		UTA015.4	create/edit the engineering drawings for simple engineering objects using 2D drafting software	3	-			
		UTA015.5	create/edit 3D models of engineering components using 3D modelling software.	3	-			
UTA003	COMPUTER PROGRAMMING	UTA003.1	comprehend concepts related to computer hardware and software, draw flowcharts and write algorithm/pseudocode.	3	-	2.00	NA	2.00
		UTA003.2	write, compile and debug programs in C language, use different data types, operators and console I/O function in a computer program	3	-			
		UTA003.3	design programs involving decision control statements, loop control statements, case control structures, arrays, strings, pointers, functions and implement the dynamics of memory by the use of pointers.	1	-			
		UTA003.4	comprehend the concepts of linear and Non-Linear data structures by implementing linked lists, stacks and queues.	1	-			
UCB008	APPLIED CHEMISTRY	UCB008.1	concepts of electrodes in electrochemical cells, migration of ions, liquid	1	2.77	1.83	2.79	2.03

			junction potential and conductometric titrations					
		UCB008.2	atomic and molecular spectroscopy fundamentals like Beer`s law, flame photometry, atomic absorption spectrophotometry, UV-Vis and IR	2	2.82			
		UCB008.3	water and its treatment methods like lime soda and ion exchange	1	2.82			
		UCB008.4	concept of phase rule, fuel quality parameters and alternative fuels	2	2.69			
		UCB008.5	polymerization, molecular weight determination and applications as biodegradable and conducting polymers	2	2.84			
		UCB008.6	laboratory techniques like pH metry, potentiometry, colourimetry, conductometry and volumetry	3	2.82			
UEE001	ELECTRICAL ENGINEERING	UEE001.1	Apply networks laws and theorems to solve electric circuits.	1	2.78	2.60	2.78	2.64
		UEE001.2	Analyze transient and steady state response of DC circuits.	3	2.78			
		UEE001.3	Signify AC quantities through phasor and compute AC system behaviour during steady state	3	-			
		UEE001.4	Expalin and analyze the behaviour of transformer	3	-			
		UEE001.5	Elucidate the principle and charcteristics of DC motor and DC generator	3	-			
UEN002	ENERGY AND ENVIRONMENT	UEN002.1	Comprehend the interdisciplinary context with reference to the environmental	2	2.48	1.25	2.48	1.50

			issues and case studies					
		UEN002.2	Assess the impact of anthropogenic activities on the various elements of environment and apply suitable techniques to mitigate their impact.	2	2.50			
		UEN002.3	Conceptualise and explain the structural and functional features of ecological systems	1	2.48			
		UEN002.4	Correlate environmental concerns with the conventional energy sources associated and assess the uses and limitations of non-conventional energy technologies	0	2.47			
UES009	MECHANICS	UES009.1	determine resultants in plane force systems	2	2.79	1.67	2.75	1.88
		UES009.2	identify and quantify all forces associated with a static framework	2	2.77			
		UES009.3	draw Shear Force Diagram and Bending Moment Diagram in various kinds of beams subjected to different kinds of loads	1	2.69			
UMA004	MATHEMATICS – II	UMA004.1	solve the differential equations of first and 2nd order and basic application problems described by these equations.	2	2.64	2.50	2.63	2.53
		UMA004.2	determine the Laplace transformations and inverse Laplace transformations of various functions and its applications to solve initial value and boundary value problems.	2	2.64			
		UMA004.3	determine the Fourier series	3	2.54			

			expansions of periodic functions and its applications to solve second order partial differential equations such as such as wave/heat equations.					
		UMA004.4	solve systems of linear equations by using elementary row operations and identify the vector spaces/subspaces to compute their bases. Further, students will be able to express linear transformation in terms of matrix and find the eigen values and vectors	3	2.69			
UTA016	ENGINEERING DESIGN PROJECT – I	UTA016.1	simulate trajectories of a mass with and without aerodynamic drag using a spreadsheet based software tool to allow trajectories be optimized	3	2.58	3.00	2.49	2.90
		UTA016.2	perform a test to acquire an engineering material property of strength in bending and analyze the throwing arm of the "Mangonel" under conditions of static and dynamic loading;	3	2.50			
		UTA016.3	develop and test software code to process sensor data	3	2.46			
		UTA016.4	design, construct and test an electronic hardware solution to process sensor data	3	2.46			
		UTA016.5	Construct and operate a Roman catapult "Mangonel" using tools, materials and assembly instructions, in a group, for a competition.	3	2.48			
		UTA016.6	Operate and evaluate the innovative redesign of elements of the "Mangonel" for functional and structural	3	2.48			

			performance.					
UTA027	ARTIFICIAL INTELLIGENCE	UTA027.1	Comprehend the basics of Artificial Intelligence and representing various problem domains using knowledge representation schemes.	3	2.59	3.00	2.54	2.91
		UTA027.2	Apply various artificial intelligence techniques for obtaining solutions to real-life problems.	3	2.57			
		UTA027.3	Understand the fundamentals of neural networks, machine learning, and computer vision.	3	2.52			
		UTA027.4	Comprehend the applicability of Artificial Intelligence techniques in real world.	3	2.50			
UTA024	ENGINEERING DESIGN PROJECT-II	UTA024.1	Recognize issues to be addressed in a combined hardware and software system design.	3	2.23	3.00	2.26	2.85
		UTA024.2	Draw the schematic diagram of an electronic circuit and design its PCB layout using CAD Tools.	3	2.29			
		UTA024.3	Apply hands-on experience in electronic circuit implementation and its testing.	3	2.29			
		UTA024.4	Demonstrate programming skills by integrating coding, optimization and debugging for different challenges.	3	2.22			
		UTA024.5	Develop group working, including task sub-division and integration of individual contributions from the team.	3	2.29			
UTA026	MANUFACTURING PROCESSES	UTA026.1	develop simple CNC code, and use it to produce components while working in groups.	3	2.53	3.00	2.48	2.90

		UTA026.2	analyse various machining processes and calculate relevant quantities such as velocities, forces.	3	2.53			
		UTA026.3	recognise cutting tool wear and identify possible causes and solutions.	3	2.47			
		UTA026.4	understand the basic principle of bulk and sheet metal forming operations for analysis of forces.	3	2.44			
		UTA026.5	analyse various shearing operations for tooling design.	3	2.43			
		UTA026.6	apply the knowledge of metal casting for different requirements.	3	2.47			
		UTA026.7	analyse and understand the requirements to achieve sound welded joint while welding different similar and dissimilar engineering materials.	3	2.50			
UES017	SOLID AND STRUCTURES	UES017.1	Evaluate axial stresses and strains in various determinate and indeterminate structural systems	1	2.58	2.00	2.59	2.12
		UES017.2	Calculate load carrying capacity of columns and struts and their buckling strength	3	2.64			
		UES017.3	To study the effect of combined stresses and strains	2	2.56			
		UES017.4	Determine deformations and deflections in various kinds of beams and trusses	2	2.58			
UME307	ENGINEERING FLUID MECHANICS	UME307.1	Analyze and solve the problems of fluid interaction with solid surfaces in static condition.	3	2.23	1.75	2.20	1.84
		UME307.2	Derive and solve the description of fluid kinematics	2	2.21			

			problems and determination of dimensionless groups using Buckingham's Pi method.					
		UME307.3	Derive and solve(simplified cases) the governing equations for fluid flow (Navier-Stokes equation).	1	2.18			
		UME307.4	Analyze and solve the internal and external flows problems.	1	2.18			
UME308	MECHANICS OF MACHINES	UME308.1	Analyse a set of mechanisms to achieve desired motion transformation.	3	2.66	2.20	2.64	2.29
		UME308.2	Apply analytical methods for the evaluation of velocity and acceleration of mechanisms.	2	2.66			
		UME308.3	Analyse and construct cam profiles for different motion of follower.	3	2.63			
		UME308.4	Evaluate the unbalance in rotating/reciprocating systems and carry out their balancing.	2	2.66			
		UME308.5	Formulate equations of motion, evaluate the responses of different real life vibration	1	2.57			
UTA025	INNOVATION AND ENTREPRENEURSHIP	UTA025.1	Explain the fundamentals behind the entrepreneurial personality and their intentions	3	-	3.00	NA	3.00
		UTA025.2	Discover/create and evaluate opportunities	3	-			
		UTA025.3	Identify various stakeholders for the idea and develop value proposition for the same.	3	-			
		UTA025.4	Describe various Business Models and design a business model canvas.	3	-			
		UTA025.5	Analyse and select suitable finance and revenue models for start-up venture.	3	-			

UMA034	OPTIMIZATION METHODS	UMA034.1	Formulate and solve linear programming problems using Simplex method and its variants.	0	2.63	1.80	2.62	1.96
		UMA034.2	Solve linear goal programming problem graphically.	3	2.67			
		UMA034.3	Construct and optimize various network models	2	2.67			
		UMA034.4	To study two-person zero sum game and its solutions.	3	2.55			
		UMA034.5	Classify and modeling of queuing system.	1	2.57			
UES401	BASICS OF MATERIALS SCIENCE	UES401.1	Classify engineering materials based on its structure.	#DIV/0!	-	NF	NA	NF
		UES401.2	Draw crystallographic planes and directions.	#DIV/0!	-			
		UES401.3	Select an appropriate strengthening mechanism to enhance the strength of the material.	#DIV/0!	-			
		UES401.4	Classify materials based on their electrical and magnetic properties.	#DIV/0!	-			
		UES401.5	Propose a solution to prevent corrosion.	#DIV/0!	-			
UMA011	NUMERICAL ANALYSIS	UMA011.1	learn how to obtain numerical solution of nonlinear equations using bisection, secant, Newton, and fixed-point iteration methods.	2	2.49	1.75	2.42	1.88
		UMA011.2	solve system of linear equations numerically using direct and iterative methods.	2	2.43			
		UMA011.3	learn how to approximate the functions using interpolating polynomials.	1	2.35			
		UMA011.4	learn how to solve definite	2	2.40			

			integrals and initial value problems numerically.					
UME404	MECHANICS OF DEFORMABLE BODIES	UME404.1	calculate the state of stress at the critical point of the object	3	2.51	2.83	2.50	2.77
		UME404.2	establish 3D stress-strain relationship for isotropic materials	3	2.51			
		UME404.3	conduct the failure analysis under static loading in ductile and brittle materials using different theories of failures	3	2.54			
		UME404.4	calculate deflection at any point on a solid structure using Castigliano's theorems	3	2.48			
		UME404.5	determine the distribution of circumferential and radial stress along the thickness of thick cylinders	2	2.45			
		UME404.6	model and analyze real structures or engineering systems through projects/assignments	3	2.48			
UME410	MECHATRONIC SYSTEMS	UME410.1	calculate the output to input relation of any physical model in the form of a transfer function using block siagram and signal flow graphs	1	2.00	2.40	1.92	2.30
		UME410.2	develop the block diagram of any mechatronic system after analyzing the key inputs, outputs, sensors, transducers and controllers of any physical device	3	2.00			
		UME410.3	interface different sensors, actuators, micro-controllers and data acquisition cards of a given mechatronic device to the computer/laptop	3	1.80			
		UME410.4	develop the state-space	2	1.80			

			representation of the physical model and analyze the performance and stability of the system in MATLAB environment					
		UME410.5	analyze the key features of different type of controllers and develop a suitable controller to obtain the desired performance from the system	3	2.00			
UME412	COMPUTER AIDED DESIGN AND ANALYSIS	UME412.1	interpret mechanical drawings for components, assemblies and use parametric 3D CAD software tools in the correct manner for creating their geometric part models, assemblies and automated drawings	2	2.80	2.50	2.78	2.56
		UME412.2	create assembly of mechanism from schematic or component drawing and conduct position/ path/ kinematic / dynamic analysis of a mechanism in motion using CAD software tools	3	2.66			
		UME412.3	evaluate design and create an optimized solution using commercial CAD, CAE software as black box for required analysis of mass properties/ stress, deflection / temperature distribution etc under realistic loading and constraining conditions	3	2.83			
		UME412.4	produce design reports for Geometric modelling, Assembly, drawings, analysis, evaluation of results, reflection and suggestions for design evaluation and improvement	2	2.83			

UES004	THERMODYNAMICS	UES004.1	analyze and solve problems related to closed systems and steady-flow devices by applying the conservation of energy principle	2	2.64	2.50	2.61	2.52
		UES004.2	analyze the second law of thermodynamics for various systems and to evaluate the performance of heat engines, refrigerators and heat pumps	2	2.58			
		UES004.3	estimate vapor-liquid properties and solve basic problems using steam tables, Mollier diagrams and equation of state	3	2.64			
		UES004.4	apply the first and second laws of thermodynamics for the complete thermal analysis of vapor power cycle	3	2.58			
UME515	INDUSTRIAL ENGINEERING	UME515.1	obtain productivity indices to evaluate effectiveness of resource utilization	3	2.10	2.40	2.09	2.34
		UME515.2	analyze line balancing issues in a product layout for improving cycle times	2	2.12			
		UME515.3	apply quality engineering tools for process control and improvement	3	2.07			
		UME515.4	develop a production schedule using information/data from different functional areas	3	2.07			
		UME515.5	determine the time standards using work study principles/human factors in engineering	1	2.07			
UME408	MACHINE DESIGN-I	UME408.1	select the suitable materials and manufacturing considerations.	2	2.38	2.60	2.33	2.55
		UME408.2	calculate stresses involved	3	2.30			

			with static/ fatigue loading					
		UME408.3	represent machine elements with a free body diagram and solve for unknown reactions	3	2.33			
		UME408.4	conduct a failure analysis for the design/sizing of mechanical components	2	2.30			
		UME408.5	design and analyze a real engineering system through projects/assignments	3	2.33			
UME718	APPLIED THERMODYNAMICS	UME718.1	Derive and analyze Otto Cycle, Diesel cycle and Dual cycle air standard efficiencies.	3	2.26	1.25	2.20	1.44
		UME718.2	Derive and analyze simple Brayton cycle.	1	2.29			
		UME718.3	Determine and analyze the performance parameters of I.C. engines in an engine test rig.	0	2.26			
		UME718.4	To prepare heat balance sheet of the boiler.	1	2.01			
UME509	MANUFACTURING TECHNOLOGY	UME509.1	Estimate the forces, power and energy requirements during forging and rolling	3	2.47	2.20	2.35	2.23
		UME509.2	Recognize the manufacturing processes for processing of plastics & ceramics	2	2.59			
		UME509.3	Identify suitable casting technique for a particular application based on the differentiation in process salient feature	3	2.26			
		UME509.4	Design the gating and riser system for the casting process and calculate the charge constituents in liquid metal	0	2.21			
		UME509.5	Evaluate the heat flow and select suitable welding	3	2.20			

			technique for different applications					
UME517	MATERIALS ENGINEERING & METALLURGY	UME517.1	develop and critically analyze the phase diagrams of isomorphous alloys, eutectic series alloys, and iron-carbon alloys	2	2.82	2.40	2.83	2.49
		UME517.2	describe phases/microstructures that exist in a given engineering material for analyzing its structure-mechanical property relationship	3	2.88			
		UME517.3	obtain and interpret information from the TTT curves and CCT diagrams of different alloys.	2	2.81			
		UME517.4	select and analyze suitable heat treatment/case hardening process for improvement in specific	2	2.82			
		UME517.5	suitably select an advanced mechanical engineering material for a given industrial application	3	2.82			
UME511	AUTOMOBILE ENGINEERING	UME511.1	evaluate the power requirement of a vehicle under different operating conditions.	2	2.82	1.67	2.82	1.90
		UME511.2	calculate the energy losses and define the design parameters in different vehicle components	0	2.82			
		UME511.3	solve the technical issues related to vehicle design and malfunctioning of different components through fault-diagnosis and troubleshooting exercises of real case studies performed at the vehicle service stations.	3	2.82			

UME700	GROUP PROJECT	UME700.1	Identify a problem based on the need analysis of community /industry/ research	#N/A	#N/A	NF	NA	NF
		UME700.2	Create a flowchart of methodology for solving the identified problem	#N/A	#N/A			
		UME700.3	Demonstrate team work with work division, team meetings and communications among team members	#N/A	#N/A			
		UME700.4	Write technical report for the project work and present the same through power point presentations or posters	#N/A	#N/A			
UPE602	SUPPLY CHAIN MANAGEMENT	UPE602.1	explore opportunities for cost reduction through Supply Chain efficiency,	#N/A	#N/A	NF	NA	NF
		UPE602.2	assess demand versus supply and use it for aggregate planning	#N/A	#N/A			
		UPE602.3	optimize product availability to improve revenue streams	#N/A	#N/A			
		UPE602.4	assess performance of a supply chain – up stream as well as down stream	#N/A	#N/A			
		UPE602.5	assess vulnerability in supply chains	#N/A	#N/A			
UPE601	FACILITY PLANNING	UPE601.1	Classsify the characterstic features and production structures of different layouts	#N/A	#N/A	NF	NA	NF
		UPE601.2	Analyse an existing facility in context to its location and design	#N/A	#N/A			
		UPE601.3	Develop a new plant layout or to improve an existing layout	#N/A	#N/A			
		UPE601.4	Design/re-design proposed a new material handling system	#N/A	#N/A			
UME699	PROJECT SEMESTER	UME699.1	collect the relevant	#DIV/0!	-	NF	NA	NF

			information to identify the problems and formulate the 'Problem definition'.					
		UME699.2	analyze the problem with appropriate model to formulate solution using established research methods and review of literature.	#DIV/0!	-			
		UME699.3	design or formulate the solution as per problem definition for solving the problem as per need or requirements.	#DIV/0!	-			
		UME699.4	prepare a project report in specified format and grammar using proper citations and deliver the verbal presentation with the associated questionnaires.	#DIV/0!	-			
		UME699.5	involve in assigned job by adopting new work environments in context of technology developments.	#DIV/0!	-			
UME707	MACHINE DESIGN-II	UME707.1	select the suitable materials and identification of the manufacturing methods.	3	2.37	3.00	2.35	2.87
		UME707.2	design and analyze failure of gears for different loading conditions.	3	2.35			
		UME707.3	select bearings for a given load carrying capacity	3	2.35			
		UME707.4	apply different theories for designing friction clutch and brakes.	3	2.34			
		UME707.5	design and analyze the real engineering system through design assignment.	3	2.35			
		UME707.6	assemble, disassemble and	3	2.35			

			generate the detail drawings of the existing or new mechanical system/subsystem					
UME720	HEAT TRANSFER	UME720.1	apply the principles of conduction, convention and radiation mode of heat transfer to solve heat transfer problems.	3	2.24	3.00	2.23	2.85
		UME720.2	calibrate equipment, acquire, tabulate and analyze useful data in the laboratory, checks for repeatability and reproducibility.	3	2.23			
		UME720.3	evaluate the thermal performance of heat exchangers and analyze and recognize their requirements of heat transfer optimization and pressure drop minimization.	3	2.23			
		UME720.4	assess and evaluate the thermal performance of systems for radiation heat transfer and its applications.	3	2.23			
UME719	REFRIGERATION AND AIR CONDITIONING	UME719.1	determine the COP for different types of air refrigeration systems	3	2.67	2.20	2.64	2.29
		UME719.2	determine the COP for vapour compression systems and heat pump	3	2.66			
		UME719.3	perform thermodynamic analysis of absorption refrigeration systems and steam jet refrigeration	2	2.63			
		UME719.4	perform the load calculations for the different type of air conditioning systems	2	2.64			
		UME719.5	identify and determine the heating and cooling loads for air conditioning systems	1	2.59			

			involving					
UHU005	HUMANITIES FOR ENGINEERS	UHU005.1	Improve the understanding of human behavior with the help of interplay of professional, psychological and economic activities.	#DIV/0!	2.67	NF	2.66	NF
		UHU005.2	Able to apply the knowledge of basic principles of psychology, economics and ethics for the solution of engineering problems.	#DIV/0!	2.66			
		UHU005.3	Explain the impact of contemporary issues in psychology, economics and ethical principles on engineering.	#DIV/0!	2.63			
UME723	FLUID MACHINES	UME723.1	Derive and apply thermodynamic and fluid terminology to fluid machines	3	2.66	2.75	2.64	2.73
		UME723.2	Determine the parameters affecting performance pumps and turbine	2	2.65			
		UME723.3	Draw the velocity triangles in turbo machinery stages operating at design and offdesign conditions	3	2.62			
		UME723.4	Determine methods to analyze flow behavior depending upon nature of working fluid and geometric configuration of fluid machinery	3	2.62			
UME513	DYNAMICS AND VIBRATIONS	UME513.1	apply engineering principle of mechanics to design motion transmission devices and flywheels	3	2.92	2.75	2.92	2.78
		UME513.2	determine the appropriate parameters for stability of a vehicle using the concept of gyroscopic action	2	2.92			

		UME513.3	derive the dynamic model of real-life problems and verify the natural frequencies and mode shapes	3	2.92			
		UME513.4	analyze two- and multi-DOF physical systems analytically and validate using a commercial package	3	2.92			
UME793	CAPSTONE PROJECT	UME793.1	identify a need of society/industry at large and formulate it into a specific engineering design problem	3	2.68	3.00	2.67	2.93
		UME793.2	design a mechanical system implementing an integrated system design approach applying knowledge accrued in various professional courses	3	2.68			
		UME793.3	recognize the importance of engineering design solutions with consideration ofsafety, economic, environmental and societal factors	3	2.71			
		UME793.4	evaluate and analyze the design considering various requirements like reliability, design optimality, manufacturing and assembly feasibility, ease of installation and maintenance, etc using applicable design / industry standards	3	2.69			
		UME793.5	create production drawings for mechanical components and systems following relevant standards and conventions	3	2.65			
		UME793.6	use suitable manufacturing/fabrication techniques to produce components and/or simulation tools to analyse the	3	2.65			

			working/performance of the designed product/system					
		UME793.7	demonstrate team work by actively participating/contributing in the group project work	3	2.65			
		UME793.8	communicate effectively with a range of audiences including peers	3	2.65			
UME518	INTRODUCTION TO ROBOTICS	UME518.1	Develop the Forward-Kinematic model/arm equation and algorithmic scheme for finding the solution for the inverse kinematics of a given serial robotic manipulator	#DIV/0!	-	NF	NA	NF
		UME518.2	Design and analyze a robotic manipulator or develop specifications of a robotic device required for planned application/s considering its integration with other work cell devices.	#DIV/0!	-			
		UME518.3	Develop and analyze the mathematical model for a robotic controller considering trajectory planning and resolved motion rate control for a given robotic manipulator.	#DIV/0!	-			
		UME518.4	Design and implement motion planning and navigation algorithms for a mobile robotic device	#DIV/0!	-			
UME525	VEHICLE DYNAMICS	UME525.1	characterize the behaviour of vehicle systems and subsystems	3	2.45	2.00	2.39	2.08
		UME525.2	develop computer models of linkages and complete working assemblies in two and	2	2.35			

			three dimensions.					
		UME525.3	develop models of vehicles for analysis of kinematics, (velocities and accelerations), kinetics (forces and moments).	0	2.40			
		UME525.4	perform simulations of rigid multi-body assemblies and calculation of loads, dynamic forces, energy and momentum in two and three dimensions.	3	2.35			
UME524	ADDITIVE MANUFACTURING	UME524.1	Implement the concepts of transformation and solid modeling in developing a solid model.	3	2.80	3.00	2.80	2.96
		UME524.2	Examine & detect the errors in .stl files and implement a suitable repair algorithm.	3	2.80			
		UME524.3	Identify suitable process and process parameters required for fabricating a part through additive manufacturing.	3	2.80			
		UME524.4	Evaluate the effect of slicing methods, design of support structures, and part deposition orientation on volumetric shrinkage and accuracy of the developed parts.	3	2.80			
UME839	RENEWABLE ENERGY SYSTEMS	UME839.1	Calculate the terrestrial solar radiation on an arbitrary tilted surface.	3	2.25	3.00	2.28	2.86
		UME839.2	Use flat-plate solar collector mathematical model to calculate the efficiency and performance parameters of the same.	3	2.10			
		UME839.3	determine the plant efficiency of geothermal plant	3	2.55			
		UME839.4	select factors that are required	3	2.18			

			to consider when selecting sites for tapping renewable energy.					
		UME839.5	determine maximum efficiency and maximum obtainable power from a given wind turbine.	3	2.33			
UPE705	COMPUTER AIDED MANUFACTURING	UPE705.1	create a plan for machining of a given part on a multi-axis CNC machining center including selection of machining parameters, cutting tools, process sequence and controller settings for tool presets.	1	2.14	1.00	2.14	1.23
		UPE705.1	create and validate a CNC part program data using manual data input (MDI) / commercial CAM package for machining of component using a CNC machining centre.	1	2.14			
		UPE705.1	Analyse and apply the appropriate automated manufacturing support system.	1	2.14			
UME737	CONDITION MONITORING OF ROTATING MACHINES	UME737.1	evaluate data sources and data quality in the context of rotating machinery faults	3	2.70	3.00	2.67	2.93
		UME737.2	work in groups to demonstrate proficiency at use of analytical tools and justify the use of methods selected	3	2.55			
		UME737.3	use data and analytical tools to make predictive diagnosis regarding data from actual faults from rotating machinery equipment.	3	2.75			
UME722	SYSTEM MODELLING AND SIMULATION	UME722.1	frame bond graph models of systems using power variables, reference power	3	2.46	2.75	2.43	2.69

			directions, causality.					
		UME722.2	generate the system equations from bond graph models.	2	2.43			
		UME722.3	develop bond graph models of structural/thermal systems	3	2.46			
		UME722.4	create different control systems and stability analysis using bond graph.	3	2.37			
UME857	ADVANCED MECHANICAL VIBRATION	UME857.1	Ability to define, formulate and solve advanced problems of mechanical vibrations	3	3.00	3.00	3.00	3.00
		UME857.2	Being able to provide information about determining Natural Frequencies and Mode shapes	3	3.00			
		UME857.3	Being able to provide information about determining forced response	3	3.00			
UME841	MODERN AUTOMOBILE ENGINEERING	UME841.1	understand the function of electronic systems in modern automobiles.	2	2.77	2.67	2.71	2.67
		UME841.2	evaluate the use of modern electronics technology to improve the performance, safety, comfort and related issues.	3	2.68			
		UME841.3	synthesize and specify the addition of new features in existing electronic automotive subsystems for enhanced functionality.	3	2.68			
UME856	TOTAL QUALITY MANAGEMENT	UME856.1	analyze various obvious and hidden quality costs of a firm for quality system economics	3	3.00	3.00	3.00	3.00
		UME856.2	apply various quality control tools for troubleshooting to reduce sporadic quality problems	3	3.00			

		UME856.3	conduct process capability analysis	3	3.00			
		UME856.4	perform line and angular measurements using appropriate metrological instruments	3	3.00			
UPE703	METAL FORMING	UPE703.1	Decide yielding of a material according to different yield theory for a given state of stress	3	2.81	3.00	2.78	2.96
		UPE703.2	analyze the different bulk metal forming process mechanics using different analysis approach and calculate the force, power requirements etc.	3	2.77			
		UPE703.3	Calculate the die and punch sizes for different sheet metal operations and to calculate the required load for the process	3	2.77			
		UPE703.4	Evaluate the effect of process parameters on the process mechanics during bulk metal forming.	3	2.77			
UME836	OPERATIONS MANAGEMENT	UME836.1	analyze the fundamental theory of operations and production management	3	2.90	2.50	2.90	2.58
		UME836.2	analyze forecasting problems or issues faced by service and manufacturing industries	2	2.90			
		UME836.3	solve problems on materials requirement planning, aggregate production planning	3	2.89			
		UME836.4	analyze inventory management problems	2	2.91			
UPE503	LEAN AND AGILE MANUFACTURING	UPE503.1	Apply the procedure of manufacturing management to prepare aggregate plans and schedules for manufacturing	3	2.48	2.60	2.46	2.57

			systems					
		UPE503.2	Evaluate the set up changeover procedures, identify areas of improvement and improve them	3	2.44			
		UPE503.3	Apply the concept, principles and techniques of lean manufacturing to reduce waste and improve productivity of manufacturing systems	2	2.44			
		UPE503.4	Evaluate agility in manufacturing systems, identify areas of improvement and develop action plans	3	2.44			
		UPE503.5	Apply the concept, structure and essentials of Industry 4.0 to improve processes and their integration	2	2.49			
UME831	COMPUTATIONAL FLUID DYNAMICS	UME831.1	Derive and analyse the various types of fluid flow governing equations	3	2.92	3.00	2.90	2.98
		UME831.2	Analyse the internal fluid flow phenomena of thermal and fluid system	3	2.87			
		UME831.3	Simulate engineering problems using commercial CFD tools	3	2.92			
UME853	SOLAR ENERGY ENGINEERING	UME853.1	calculate incident solar irradiance (diffuse and direct components) on flat and inclined surfaces for a given geographical location	3	2.88	3.00	2.88	2.98
		UME853.2	identify optimum heat transfer fluids for solar energy utilization	3	2.88			
		UME853.3	select solar selective materials and optimum geometric configurations for harnessing solar energy	3	2.88			

		UME853.4	draw thermal resistance diagrams relevant to the constituents elements of a given solar thermal system	3	2.88			
		UME853.5	evaluate the thermal and optical performance of PV and solar thermal systems	3	2.88			

1.3 Attainment of Program Outcomes and Program Specific Outcomes

1.3.1 Describe assessment tools and processes used for measuring the attainment of each Program Outcome and Program Specific Outcomes

A. <u>Assessment Tools used for measurement of Program Outcome attainment:</u>

In the Outcome Based Education (OBE), the course outcome attainment scores measured using direct and indirect assessment tools are eventually used for measuring the attainment of Program Outcomes and Program specific outcomes. Thus, PO and PSO assessment process uses both direct and indirect measures to measure the attainment of each outcome. The examples of such measures are given below:

1. Direct Assessment tools:

After evaluating the attainment of course outcomes using direct assessment tools (as mentioned in Table 1.2.1 (a)), average direct CO score for each course is computed. Direct assessment score for attainment of PO and PSO is computed by mapping the direct CO scores for all courses with corresponding PO's as defined in the Program articulation matrix. Following direct assessment tools are employed for measuring PO /PSO attainment:

- Mid Semester Examinations [Once during 8th or 9th week of a semester]
- End semester Examination [once during 15th week of the semester]
- Tutorial Assignments [Varies depending on the tutorial engagement]
- Quizzes [Mostly once during semester, Varies and is decided by course coordinator]
- Projects [Mostly once during semester, Varies and is decided by course coordinator]

2. Indirect Assessment tools:

This includes feedbacks from all the stakeholders such as course exit survey, Graduating student survey, alumni feedback, Employer feedback etc.

Table 1.3.1: **Indirect Assessment Tools**

S. No.	Indirect Assessment Tool	Method Description
1	Course Survey [Twice before MST and EST]	Course Survey is completed for every course in each semester to get a formal feedback from students for the courses offered in a semester and provide objective information to the faculty for self-appraisal, self-improvement & development. The course survey is focussed on attainment of course outcomes. Formal student feedback is obtained online and it is mandatory for all students to participate in such surveys. The course survey results are compiled by the individual course instructors for his feedback.

2	Graduating student's survey [Once per year for the graduating batch]	A questionnaire survey is used to measure the level of achievement of expected program outcomes/program specific outcomes. It is mandatory for all graduating students to participate in this questionnaire. Each participant is asked to rate his/her perception of achievement of the program outcomes/program specific outcome on a scale of 1 to 5 where 1 signifies a poor outcome and 5 signifies a high level of achievement of objectives. The indirect CO scores measured through this tool are mapped to Likert scale of 1 to 3. The assessment results are documented and discussed in the meeting of department faculty to make action points for initiating corrective and preventive actions. A sample copy of graduating students' survey form is provided in **Annexure-1.1**
3	Alumni survey [Once per year- After 2-5 years of graduation]	It is believed that the perception of students changes from the time of graduation to some point in their respective careers as they get more mature and have learnt tricks of the trade on the job. At this point of time, they are in a better position to provide more valuable and objective feedback on the learning in their undergraduate program and also how much of the program outcomes (on some scale) have actually been possible. To obtain this information, a survey is conducted for practicing alumni who graduated during the last 2 to 5 years. This survey like the graduating student survey is targeted at the program outcomes & program specific outcomes achieved during the last 2 to 5 years. Again, the respondents are asked to rate each PO and PSO on a scale of 1 to 5. The indirect CO scores measured through this tool are mapped to Likert scale of 1 to 3. The findings of the survey are processed and used for effecting improvements in the program to achieve the program educational objectives and program outcomes. A sample copy of alumni survey form is provided in **Annexure-1.2.**
4	Employer survey [Once per year- After 1-2 years of graduation]	All the students of program to be accredited are required to spend a full six month's semester in the industry completing an industrial project under the joint supervision of industry supervisors and TIET faculty. All the faculty members are required to visit one or two organizations two times during their six month's semester in the industry for evaluation of students placed for their work term in these organizations. This provides an opportunity to take feedback of our graduated students working in these organizations. During the course of interaction with the employer of our students, the employers provide information on their performance against POs & PSOs through survey form. This form, like the other forms, has questions related to the POs & PSOs. The rating is again given on a scale of 1 to 5 with 5 representing the best performance. The indirect CO scores measured through this tool are mapped to Likert scale of 1 to 3. A sample copy of employer survey form is provided in **Annexure-1.3.**

B. <u>Processes used for measurement of Program Outcome attainment:</u>

CO Attainment scores computed for each subject by direct assessment tools is mapped to correlated PO or PSO by using the weights defined in *Course Articulation Matrix*. Similarly, CO attainment scores computed through indirect assessment tools are also mapped with the correlated PO or PSO.

PO/PSO Attainment (Direct Assessment) = $\left[\frac{\text{PO\_CO Mapping}}{3} \times CO\ Attainment\ (Direct\ Assessment\right]$

PO/PSO Attainment (Indirect Assessment) = $\left[\frac{\text{PO\_CO Mapping}}{3} \times CO\ Attainment\ (Indirect\ Assessment\right]$

Attainment for a program outcome is finally computed by taking weighted average of contributions of participating courses towards that particular PO or PSO.

Finally, program outcomes for entire course is assessed by taking weighted sum of direct and indirect assessment as

Overall PO/PSO = 80% weightage of direct PO Score + 20% weightage of Indirect PO Score

1.3.2 Provide results of evaluation of each PO & PSO

The PO/ PSO attainment levels computed by direct (student performance) are presented below in Table B 1.3.2 (a).

Table B.1.3.2a

COURSE NO.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
UEC001	2.64	-	-	2.70	2.64	-	-	-	2.67	-	-	-	-	-
UHU003	-	-	-	-	-	-	-	-	-	2.62	-	-	-	-
UMA010	2.22	-	-	-	-	-	-	-	-	-	-	-	-	-
UPH004	1.60	-	1.50	-	-	-	-	-	-	-	-	2.00	-	-
UTA015	2.00	-	-	-	3.00	-	-	-	2.57	-	-	-	3.00	3.00
UTA003	2.00	2.00	1.00	1.00	2.20	-	-	2.00	2.00	-	1.80	2.00	2.00	2.00
UCB008	1.83	1.83	-	-	-	1.83	1.83	-	-	-	-	1.83	-	-
UEE001	2.57	2.57	-	-	-	-	-	-	2.33	-	-	-	-	-
UEN002	1.25	-	0.80	-	-	1.25	1.40	-	-	-	-	-	-	-
UES009	1.71	1.71	-	-	-	-	-	-	-	-	-	-	1.80	-
UMA004	2.45	-	-	-	-	-	-	-	-	-	-	-	-	-
UTA016	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
UTA027	3.00	3.00	3.00	-	3.00	-	-	-	-	-	-	3.00	-	3.00

UTA024	3.00	3.00	3.00	3.00	3.00	-	-	-	3.00	3.00	3.00	3.00	-	-
UTA026	3.00	3.00	-	-	-	-	-	-	3.00	-	-	3.00	-	3.00
UES017	1.89	1.90	-	-	-	-	-	-	-	-	-	-	2.00	-
UME307	1.75	1.75	-	-	-	-	-	-	-	-	-	-	1.75	-
UME308	2.08	2.15	-	-	-	-	-	-	-	-	2.00	-	3.00	2.00
UTA025	-	3.00	3.00	-	3.00	3.00	3.00	-	3.00	3.00	3.00	3.00	-	-
UMA034	1.75	0.00	-	-	-	-	-	-	-	-	2.00	-	-	-
UES401	0.83	-	2.00	-	-	-	-	-	-	-	-	-	0.00	-
UMA011	1.75	1.75	-	-	-	-	-	-	-	-	-	1.75	-	-
UME404	2.83	2.85	-	-	-	-	-	-	3.00	3.00	-	3.00	3.00	3.00
UME410	1.88	2.00	2.00	3.00	2.67	-	-	-	-	3.00	-	-	2.00	2.40
UME412	2.50	-	3.00	2.50	2.33	-	-	-	2.50	2.00	-	2.50	3.00	-
UES004	2.50	2.50	-	-	-	-	-	-	-	-	-	-	-	-
UME515	2.33	2.50	-	3.00	3.00	-	-	-	-	-	-	-	-	2.75
UME408	2.64	2.64	2.63	-	-	-	-	-	3.00	3.00	-	-	2.50	2.60
UME718	1.40	1.25	-	-	-	-	-	-	0.00	0.00	-	-	0.00	-
UME509	2.20	2.00	-	-	-	-	-	-	-	-	-	-	1.67	3.00
UME517	2.50	2.50	-	2.00	-	-	-	-	-	2.00	-	3.00	3.00	2.00
UME511	1.67	-	-	-	-	1.50	1.80	-	-	-	-	2.75	3.00	3.00
UME699	3.00	3.00	3.00	3.00	-	-	-	-	-	3.00	3.00	3.00	-	-
UME707	3.00	3.00	3.00	-	-	-	-	-	3.00	3.00	-	-	3.00	3.00
UME720	3.00	3.00	3.00	3.00	3.00	-	-	-	-	3.00	-	-	-	3.00
UME719	2.15	2.20	2.13	-	2.20	2.23	-	2.20	-	-	-	2.09	2.20	-
UHU005	-	-	-	-	-	3.00	-	3.00	3.00	3.00	3.00	-	-	-
UME723	2.75	2.50	-	-	-	-	-	-	-	-	-	-	-	-
UME513	2.75	2.78	-	-	3.00	-	-	-	3.00	-	-	3.00	3.00	3.00
UME793	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
UME518	0.00	0.00	0.00	-	0.00	-	-	-	-	-	-	0.00	0.00	0.00
UME525	3.00	2.00	2.00	-	3.00	3.00	-	-	3.00	-	-	3.00	1.50	2.50
UME524	3.00	3.00	3.00	3.00	3.00	-	-	-	3.00	-	-	3.00	3.00	3.00
UME839	3.00	3.00	3.00	3.00	-	-	-	-	-	-	-	-	3.00	3.00
UPE705	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
UME737	3.00	3.00	3.00	-	3.00	-	-	-	3.00	-	-	-	3.00	3.00
UME722	2.75	2.75	-	-	-	-	-	-	-	-	-	-	2.75	2.75
UME857	3.00	3.00	3.00	-	3.00	-	-	-	-	-	-	-	3.00	3.00

UME841	-	-	-	-	2.67	2.75	-	-	-	-	-	2.67	2.67	2.67
UME856	3.00	3.00	3.00	3.00	-	-	-	-	-	-	3.00	-	-	-
UPE703	3.00	3.00	3.00	3.00	-	-	-	-	3.00	-	-	3.00	3.00	3.00
UME836	2.60	-	-	-	2.40	-	-	-	2.50	-	-	-	-	-
UPE503	2.54	2.29	2.20	2.20	2.00	-	2.00	-	-	2.00	-	-	2.00	2.29
UME831	3.00	3.00	3.00	-	3.00	-	-	-	-	-	-	-	-	3.00
UME853	3.00	3.00	-	-	-	-	3.00	-	-	-	-	-	3.00	-
	2.41	**2.51**	**2.51**	**2.61**	**2.70**	**2.32**	**2.23**	**2.37**	**2.74**	**2.66**	**2.53**	**2.62**	**2.55**	**2.71**

The PO/ PSO attainment levels computed by indirect (surveys) are presented below in Table B 1.3.2 (b).

Table B.1.3.2b

COURSE NO.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
UEC001	0.00	-	-	0.00	0.00	-	-	-	0.00	-	-	-	-	-
UHU003	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-
UMA010	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-
UPH004	0.00	-	0.00	-	-	-	-	-	-	-	-	0.00	-	-
UTA015	0.00	-	-	-	0.00	-	-	-	0.00	-	-	-	0.00	0.00
UTA003	0.00	0.00	0.00	0.00	0.00	-	-	0.00	0.00	-	0.00	0.00	0.00	0.00
UCB008	2.79	2.79	-	-	-	2.79	2.79	-	-	-	-	2.79	-	-
UEE001	1.19	1.19	-	-	-	-	-	-	0.93	-	-	-	-	-
UEN002	2.48	-	2.48	-	-	2.48	2.49	-	-	-	-	-	-	-
UES009	2.75	2.75	-	-	-	-	-	-	-	-	-	-	2.76	-
UMA004	2.62	-	-	-	-	-	-	-	-	-	-	-	-	-
UTA016	2.49	2.49	2.49	2.48	2.48	2.48	2.48	2.48	2.48	2.49	2.48	2.48	2.50	2.48
UTA027	2.54	2.54	2.54	-	2.53	-	-	-	-	-	-	2.54	-	2.54
UTA024	2.26	2.26	2.27	2.26	2.26	-	-	-	2.26	2.27	2.26	2.26	-	-
UTA026	2.48	2.48	-	-	-	-	-	-	2.49	-	-	2.48	-	2.48
UES017	2.59	2.59	-	-	-	-	-	-	-	-	-	-	2.59	-
UME307	2.20	2.20	-	-	-	-	-	-	-	-	-	-	2.20	-
UME308	2.63	2.63	-	-	-	-	-	-	-	-	2.66	-	2.64	2.66
UTA025	-	0.00	0.00	-	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00	-	-
UMA034	2.61	2.63	-	-	-	-	-	-	-	-	2.67	-	-	-
UES401	0.00	-	0.00	-	-	-	-	-	-	-	-	-	0.00	-
UMA011	2.42	2.42	-	-	-	-	-	-	-	-	-	2.42	-	-

UME404	2.50	2.50	-	-	-	-	-	-	2.48	2.48	-	2.48	2.50	2.51
UME410	1.92	1.93	1.93	1.80	1.93	-	-	-	-	1.80	-	-	2.00	1.90
UME412	2.73	-	2.83	2.74	2.82	-	-	-	2.83	2.83	-	2.81	2.83	-
UES004	2.61	2.61	-	-	-	-	-	-	-	-	-	-	-	-
UME515	2.07	2.09	-	2.10	2.07	-	-	-	-	-	-	-	-	2.08
UME408	2.33	2.33	2.33	-	-	-	-	-	2.33	2.33	-	-	2.33	2.32
UME718	2.22	2.20	-	-	-	-	-	-	2.26	2.26	-	-	2.26	-
UME509	2.35	2.38	-	-	-	-	-	-	-	-	-	-	2.35	2.47
UME517	2.84	2.85	-	2.81	-	-	-	-	-	2.81	-	2.82	2.85	2.82
UME511	2.82	-	-	-	-	2.82	2.82	-	-	-	-	2.82	2.82	2.82
UME699	0.00	0.00	0.00	0.00	-	-	-	-	-	0.00	0.00	0.00	-	-
UME707	2.35	2.35	2.35	-	-	-	-	-	2.35	2.35	-	-	2.35	2.35
UME720	2.23	2.23	2.23	2.23	2.23	-	-	-	-	2.23	-	-	-	2.23
UME719	2.64	2.64	2.64	-	2.64	2.64	-	2.64	-	-	-	2.64	2.64	-
UHU005	-	-	-	-	-	2.65	-	2.66	2.67	2.63	2.67	-	-	-
UME723	2.64	2.65	-	-	-	-	-	-	-	-	-	-	-	-
UME513	2.92	2.92	-	-	2.92	-	-	-	2.92	-	-	2.92	2.92	2.92
UME793	2.68	2.69	2.70	2.67	2.67	2.69	2.69	2.68	2.66	2.66	2.66	2.67	2.68	2.67
UME518	0.00	0.00	0.00	-	0.00	-	-	-	-	-	-	0.00	0.00	0.00
UME525	2.45	2.39	2.35	-	2.35	2.45	-	-	2.35	-	-	2.40	2.42	2.35
UME524	2.80	2.80	2.80	2.80	2.80	-	-	-	2.80	-	-	2.80	2.80	2.80
UME839	2.30	2.26	2.30	2.25	-	-	-	-	-	-	-	-	2.29	2.25
UPE705	2.14	2.14	2.14	2.14	2.14	2.14	2.14	2.14	2.14	2.14	2.14	2.14	2.14	2.14
UME737	2.66	2.67	2.72	-	2.65	-	-	-	2.55	-	-	-	2.69	2.72
UME722	2.43	2.43	-	-	-	-	-	-	-	-	-	-	2.43	2.43
UME857	3.00	3.00	3.00	-	3.00	-	-	-	-	-	-	-	3.00	3.00
UME841	-	-	-	-	2.71	2.70	-	-	-	-	-	2.71	2.71	2.71
UME856	3.00	3.00	3.00	3.00	-	-	-	-	-	-	3.00	-	-	-
UPE703	2.78	2.78	2.77	2.77	-	-	-	-	2.77	-	-	2.77	2.79	2.79
UME836	2.90	-	-	-	2.90	-	-	-	2.90	-	-	-	-	-
UPE503	2.46	2.46	2.47	2.47	2.47	-	2.44	-	-	2.49	-	-	2.47	2.46
UME831	2.89	2.89	2.90	-	2.92	-	-	-	-	-	-	-	-	2.92
UME853	2.88	2.88	-	-	-	-	2.88	-	-	-	-	-	2.88	-
	2.53	**2.50**	**2.53**	**2.48**	**2.53**	**2.62**	**2.59**	**2.59**	**2.46**	**2.44**	**2.55**	**2.61**	**2.57**	**2.53**

Table B.1.3.2c

Table 1.3.2c gives the average Indirect scores as compiled from different surveys.

INDIRECT (STUDENT SURVEY)	2.53	2.50	2.53	2.47	2.55	2.58	2.59	2.52	2.45	2.41	2.57	2.61	2.57	2.53
ALUMNI SURVEY	3.00	2.78	2.70	2.85	2.78	2.70	2.78	2.70	2.93	2.85	2.78	2.78	-	-
EMPLOYER SURVEY	2.69	2.61	2.67	2.66	2.64	2.71	2.77	2.76	2.76	2.71	2.68	2.78	-	-
GRADUATING STUDENT	2.49	2.47	2.50	2.50	2.52	2.51	2.49	2.53	2.50	2.52	2.44	2.57	-	-
AVERAGE SURVEY BASED PO ATTAINMNET	**2.68**	**2.59**	**2.60**	**2.62**	**2.62**	**2.63**	**2.66**	**2.63**	**2.66**	**2.62**	**2.61**	**2.68**	**2.57**	**2.53**

Annexure 1.1

TU/sur-Form/01/UG

Survey form to assess the level of attainment of student outcomes – Graduating Students

The program of **BE Mechanical/Mechatronics/Production Engineering** has been designed with certain student outcomes (the knowledge, skills and attitudes that students develop during the course of study). The students of graduating class are requested to answer the questionnaire given in this form to assess how well they judge they have attained the student outcomes set for the program. Please answer the questionnaire on a scale of 1 to 5 where 1 indicates little achievement or skill, and 5 indicates great deal of achievement.

	SURVEY QUESTIONNAIRE	LEVEL OF ATTAINMENT (answer on a scale of 1 to 5)				
	I have achieved the ability to	1	2	3	4	5
1	apply the knowledge of mathematics, science and engineering fundamentals for solution of complex engineering problems.					
2	identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions.					
3	design solutions for complex engineering problems and system components/processes considering public health & safety, cultural, societal and environmental aspects.					
4	use research-based knowledge and methods including design of experiments, analysis & interpretation of data, and synthesis of the information.					
5	create, select, and apply appropriate techniques/ resources/ IT tools to model and predict complex engineering problems within defined constraints.					
6	apply contextual reasoning to assess societal, health, safety, legal and cultural issues and the consequent responsibilities					
7	understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.					
8	apply and commit to professional ethical principles, responsibilities and norms of the engineering practice.					
9	function effectively as an individual, as a member or leader in diverse teams and in multidisciplinary settings.					
10	communicate effectively on complex engineering activities in terms of comprehension, documentation and presentation.					
11	demonstrate the understanding of engineering and management principles and apply these to manage projects in multidisciplinary environments.					
12	recognize the need for and to engage in independent and life-long learning in the broadest context of technological change.					

What do you plan to do after graduation at TU.? Tick (√) whichever is applicable and provide details

a. Employment (give details like employer name): _____

b. Higher education (give the title of degree): _____

c. Entrepreneur (specify): _____

Student Name:_____ Regd. No.:_____

Graduating Year:_____

Suggestion, if any:_____

Annexure 1.2

TIET/sur-Form/02/UG

Survey form to assess the level of attainment of student outcomes – Alumni

Dear Alumni

It is wonderful to reconnect with you after a few years. We hope you have been doing exceedingly well in your career. We are sure that your stay with TIET has enabled you to imbibe the process of life-long learning and to take up challenging careers. We are sure you were sufficiently equipped not only to take on the real world but also make it a better place to live in through responsible and innovative use of technology. We need your support to keep the TIET flag flying high.

We solicit your feedback on attainment of the student outcomes (the knowledge, skills and attitude that you developed during the course of study at TIET and subsequent work experience) of the **BE Mechanical/Mechatronics/Production Engineering program**. Please answer the following questions on a scale of 1 to 5 where 1 indicates little achievement or skill, and 5 indicates great deal of achievement.

	SURVEY QUESTIONNAIRE	LEVEL OF ATTAINMENT (answer on a scale of 1 to 5)				
	I achieved an ability to	1	2	3	4	5
1	apply the knowledge of mathematics, science and engineering fundamentals for solution of complex engineering problems.					
2	identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions.					
3	design solutions for complex engineering problems and system components/processes considering public health & safety, cultural, societal and environmental aspects.					
4	use research-based knowledge and methods including design of experiments, analysis & interpretation of data, and synthesis of the information.					
5	create, select, and apply appropriate techniques/ resources/ IT tools to model and predict complex engineering problems within defined constraints.					
6	apply contextual reasoning to assess societal, health, safety, legal and cultural issues and the consequent responsibilities					
7	understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.					
8	apply and commit to professional ethical principles, responsibilities and norms of the engineering practice.					
9	function effectively as an individual, as a member or leader in diverse teams and in multidisciplinary settings.					
10	communicate effectively on complex engineering activities in terms of comprehension, documentation and presentation.					
11	demonstrate the understanding of engineering and management principles and apply these to manage projects in multidisciplinary environments.					
12	recognize the need for and to engage in independent and life-long learning in the broadest context of technological change.					

Note: Cross-out whichever not applicable

1) GATE exam after BE: **PASSED/FAILED/NOT TAKEN**
2) Promotion since graduation: **YES/NO**
3) Enrollment in higher studies: **YES/NO**, if **YES** please answer following
   (i) Name of program:_____ (ii) Year of completion:_____
4) Involvement in professional societies as a _____
5) Community service, if any: _____
6) Overall how satisfied are you with BE Mechanical/Mechatronics/Production Engineering program at TIET and in your opinion how well is the BE Mechanical/Mechatronics/Production Engineering program meeting its stated educational objectives: **EXCELLENT/VERY GOOD/GOOD/AVERAGE/POOR**

Your Name with signature:_____Your current organization:_____

Regd. No.:_____ Year of graduation:_____

Suggestion, if any:_____

Annexure 1.3

TIET/sur-Form/03/UG

Survey form to assess the level of attainment of student outcomes – Employer

Dear Sir

We express our sincere thanks for continually employing our graduate students over the years. We are sure our student are sufficiently equipped not only to take on the real world but also make a better place to live in through responsible and innovative use of technology.

We solicit your feedback on attainment of the student outcomes (the knowledge, skills and attitudes that students develop during the course of study at TIET) of the **BE Mechanical/Mechatronics/Production Engineering** program. Please answer the following questions on a scale of 1 to 5 where 1 indicates little achievement or skill, and 5 indicates great deal of achievement.

	SURVEY QUESTIONNAIRE	LEVEL OF ATTAINMENT (answer on a scale of 1 to 5)				
	The student has the ability to	1	2	3	4	5
1	apply the knowledge of mathematics, science and engineering fundamentals for solution of complex engineering problems.					
2	identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions.					
3	design solutions for complex engineering problems and system components/processes considering public health & safety, cultural, societal and environmental aspects.					
4	use research-based knowledge and methods including design of experiments, analysis & interpretation of data, and synthesis of the information.					
5	create, select, and apply appropriate techniques/ resources/ IT tools to model and predict complex engineering problems within defined constraints.					
6	apply contextual reasoning to assess societal, health, safety, legal and cultural issues and the consequent responsibilities					
7	understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.					
8	apply and commit to professional ethical principles, responsibilities and norms of the engineering practice.					
9	function effectively as an individual, as a member or leader in diverse teams and in multidisciplinary settings.					
10	communicate effectively on complex engineering activities in terms of comprehension, documentation and presentation.					
11	demonstrate the understanding of engineering and management principles and apply these to manage projects in multidisciplinary environments.					
12	recognize the need for and to engage in independent and life-long learning in the broadest context of technological change.					

1) What courses/topics would you like to see offered as UG course at TIET or for continuing education to your staff.

_____

_____

2) Overall how satisfied are you with BE Mechanical/Mechatronics/Production Engineering program at TIET and in your opinion how well is the BE Mechanical/Mechatronics/Production Engineering program meeting its stated educational objectives. **EXCELLENT/VERY GOOD/GOOD/AVERAGE/POOR** (Cross-out whichever not applicable.)

Your Name and Signature with date: _____

Your Organization Name:_____

Suggestion, if any:_____

1.4 Actions taken based on the results of evaluation of each of the COs, POs & PSOs

Based on the CO, PO, and PSO attainment levels, various subjects were identified whose CO attainment level was low but weightage towards calculation of a PO/PSO level was high. For such subjects, the concerned faculty prepared an action taken report (ATR) providing details of reasons for the low attainment level and the actions to improve upon the same (please see Table B.1.4.1a).

Table B.1.4.1a **POs & PSOs Attainment Levels and Actions for improvement (CAYm1: 2021-22)**

POs	Target Level	Attainment Level	Observations
PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.			
PO1	**2.10**	**2.13**	For PO1, the target level has been achieved. A total of 45 subjects were considered for calculating the attainment level of PO1. Though the PO attainment level was achieved, but there was scope for further improvement as contribution of 14 subjects towards attainment of this program objective was observed to be low. The subjects which needed improvement included UMA034, UMA011, UMA004, UME511, UME807, UME705, UCB008, UEN002, UES401, UME404, UME732, UME516, UME502 and UEE001. All these subjects had shown low CO attainment levels. Out of these subjects, UCB008, UME404, UME511, UME502, UME807, UEE001, UMA004, UME705, UMA034, UES401, UMA011and UME516 had high weightage (shown in the course-PO mapping) towards PO1. Thus, the attainment level of PO1 can be further improved by taking actions to improve the attainment level of COs of above-mentioned subjects.
The observations and actions pertaining to UCB008, UME404, UME511, UME502, UME807, UEE001, UMA004, UME705, UMA034, UES401, UMA011and UME516 are as follows:			

Action Taken Report (ATR) of Applied Chemistry (UCB 008)

Assessment Year: 2021−2022
Subject Name: Applied Chemistry
Subject Code: UCB 008
Name of Teacher submitting the ATR: Dr. Manmohan Chhibber

S.No.	Reasons for low attainment of CO	Actions taken for improvement
1.	The beginning of session 21-22 was affected by COVID 19 Pandemic. Although by Jan 22, when this course was taught, the world had started recovering from the pandemic but after effects and precautionary measures were still in place. Therefore, students were allowed to cover courses from home using recorded content from LMS. Due to which attendance in the classes was not made mandatory and therefore those who were on campus were also taking liberty of covering the syllabus using LMS rather than interacting in the class.	**A1.** It was recommended to authorities through head to block the option of online classes and take courses from home because by now the pandemic situation has improved. **A2.** It was also recommended to make the attendance in class compulsory as per institute's pre-COVID norms so that students attend and physically interact with faculties via discussion and tests.
2.	Topics like Electrochemistry, Spectroscopy and Water are new relatively to their previous knowledge of chemistry.	The faculty members taking this course were apprised of the situation and it was advised to brief the students about the basics and the terminology of the course before getting into the advance details. Also, it was decided to start a consultation process among faculty members to tone down the contents of these topics.

Action Taken Report (ATR) of Mechanics of Deformable Bodies (UME 404)

Assessment Year: 2021–2022
Subject Name: Mechanics of Deformable Bodies
Subject Code: UME404
Name of Teacher submitting the ATR: Dr. Gagandeep Bhardwaj

S.No.	Reasons for low attainment of CO	Actions taken for improvement
1.	Mechanics of Deformable Bodies (UME404) is an advanced course (three-dimensional) in the area of solids and structures. The perquisites of this course include thorough understanding of the basic concepts of Mechanics and solids and structures. However, in academic year 2020-21, it was found that the dedicated prerequisites were not understood by the students in the good way (classes conducted through online mode). Though a large number of practical examples were considered in the lecture class while introducing the relevant topics, the participation from the students for solving these problems by themselves and involvement in the calculation was not up to the mark. Since the exam involves numerical examples based on mathematical procedures, the lack of firsthand experience on calculations and solutions resulted in lower outcomes.	**A1.** A change in pedagogical initiatives is required which would be taken up when this course is taught to the next batch (e.g., changing from teaching pedagogy with assistance of ppt slides to blackboard teaching; or providing ppt slides and other relevant matter in advance to students, etc.). **A2.** Moreover, the emphasis on self-learning will be given particularly in the tutorial classes which shall enable the students to independently solve the physical systems.

Action Taken Report (ATR) of Automobile Engineering (UME502/UME511)

Assessment Year: 2021–2022
Subject Name: Automobile Engineering
Subject Code: UME502/UME511
Name of Teacher submitting the ATR: Dr. Devender Kumar

S.No.	Reasons for low attainment	Actions taken for improvement
1	The 'Automobile Engineering' is highly lab-oriented course in which class teaching is best correlated by demonstration of vehicle components in the laboratory. This course was taught during the time of pandemic (July- Dec. 2021). The students were not present on campus, so the course was run online. In online mode, neither the students could get the hands-on training of various instruments. The question in the examination needs correlation of engineering concept into real life usage of vehicle. Although, efforts were made from our side for recording the video lectures to demonstrate the functioning of various vehicle components and send it to students but it can be better understood on the equipment. This might have led to the low attainment of CO.	**A1.** The lectures classes will be made more engaging by including video recordings along with laboratory demonstration of vehicle equipment. **A2.** More interactive lab sessions will be arranged.
2	Evaluation was related to physical demonstration and fault diagnose. During the pandemic, new advanced automobile engineering topics were given to students in the form of research assignment. The evaluation was continuous (every week) and marks were deduced for late submission. Although, sufficient time extensions were given to the students but indefinite delay in submissions led to reduce the overall marks obtained by the students.	Physical presence of the students in the classrooms will probably overcome the shortcoming.

Action Taken Report (ATR) of Gas Dynamics and Turbomachinery (UME807)

Assessment Year: 2021–2022
Subject Name: Gas Dynamics and Turbomachinery
Subject Code: UME807
Name of Teacher submitting the ATR: Dr. Anu Mittal

S.No.	Reasons for low attainment of CO	Actions taken for improvement
1.	Learning outcomes of the course Gas dynamics and turbomachinery involved learning of fluid flow interaction with rotating components of rotating machinery such as gas turbine, steam turbines, compressors and blowers. This requires thorough understanding of steam properties, vector representation of velocity vectors as prerequisite of this course. Although students were provided with enough tutorial sheets for practice in the tutorial class. Still the complete learning was not reflected in the examination.	**A1.** Practice sheets related to fundamentals of steam properties, vector algebra and relative velocity to be provided and covered in the initial lectures. **A2.** Students to be shown videos/animations related to fluid flow interaction with rotating machine components before discussing analysis of force and momentum.

Action Taken Report (ATR) of Electrical Engineering (UEE001)

Assessment Year: 2021–2022
Subject Name: Electrical Engineering
Subject Code: UEE001
Name of Teacher submitting the ATR: Dr. Pawan Kumar

S. No.	Reasons for low attainment of CO	Actions taken for improvement
1.	Initially, new students have little exposure with concept of electrical engineering as compared to the science courses. Therefore, the students usually find it difficult to understand the concepts of DC network circuit discussed in the class. Though specific tutorial was planned for the topic, yet solving and understanding all the concepts may not have been carried out by the students due to core technical content, leading to poor performance in the question targeted to achieve the CO in the MST.	Supplementary practice problems, in addition to the tutorial sheets, will be given to the students for improving the performance of the students on this topic. In addition, matter related to course contents in the form of lecture slides (ppts) as well as pre-recorded video sessions (especially for concepts like DC networks, Network theorems etc.) will be provided to the students before these topics are taken up in the lecture class for better understanding of concepts.
2.	In continuation with the DC network (described in CO1), the transient network analysis is a extensive part of the DC network and this is a novel concept for the newly admitted students. It may have led to poor performance in the question targeted to achieve the CO2.	During the coverage of course content, the topic based on transient network analysis will be given extra emphasis. Also, lecture slides (ppts) as well as pre-recorded video sessions (especially for concepts like DC networks, transient networks etc.) will be provided to the students before these topics are taken up in the lecture class for better understanding of concepts.

Action Taken Report (ATR) of Mathematics-II (UMA004)		
Assessment Year: 2021–2022 Subject Name: Mathematics-II Subject Code: UMA004 Name of Teacher submitting the ATR: Dr. Parimita Roy		
S.No.	**Reasons for low attainment of CO**	**Actions taken for improvement**
1.	One primary reason is that Laplace transformation and Fourier series topics are relatively new, and some students lacked prerequisite knowledge. This deficiency hinders their ability to comprehend more advanced topics and perform well in exams.	**A1.** The faculty will be requested to give extra attention to this topic and to cover the basics of engineering mathematics. **A2.** To generate students' interest in the subject, more application-based problems in mechanical engineering that involve practical scenarios and require engineering analysis and solution will be considered.
2.	The CO2 related topics are covered just before the Mid-Semester Test (MST); many supplementary exams take place at that time. They might not have enough time to comprehend the ideas in this little amount of time fully.	**A1.** The faculties will be asked to provide additional support to students, like clearing doubts after class. **A2.** In addition, students shall be encouraged to ask questions and seek clarification from faculty members.

Action Taken Report (ATR) of Machining Science (UME705)		
Assessment Year: 2021–2022 Subject Name: Machining Science Subject Code: UME705 Name of Teacher submitting the ATR: Dr Vinod Kumar		
S.No.	**Reasons for low attainment of CO**	**Actions taken for improvement**
1.	Some of the students did not perform well in some of the topics like Merchants theory, development of strain energy relationships, frictional and thermal aspects of machining while understanding the concepts. Students need to go in detail while solving some of these specific applications.	Power point presentations and assignments related to some of the topics like Merchants theory, development of strain energy relationships, frictional and thermal aspects of machining have been provided to students to explain them for better understanding.

Action Taken Report (ATR) of Optimization Methods (UMA034)		
Assessment Year: 2021-2022 Subject Name: Optimization Methods Subject Code: UMA034 Name of the Teacher submitting the ATR: Dr. M. K. Sharma/Dr. N. Kailey		
S.No.	**Reasons for low attainment of CO**	**Actions taken for improvement**
1.	This semester was in online and offline mode both due to COVID-19. The syllabus was taught in both online and offline modes and the evaluation were done in online and offline mode both. The faculty and students were both new to online teaching pedagogy and evaluation techniques. This affected the overall output in the course outcome.	It was planned to follow a proper strategy for evaluation of outcomes taking into account, both online and offline mode of evaluations before the beginning of the semester.
2.	The syllabus required good prerequisite knowledge and the students have to complete a significant portion of their prerequisite syllabus in the online mode due to pandemic. In Written examination (offline mode in which most of the course out comes were evaluated) the students were given the option to attempt 5 out for 7 questions (As per Institute policy due to COVID). In view of this students did selective preparation of the topics. Game theory, Queuing theory and Goal programming (difficult topics as compare to others) were opted by very few students and the performance was not satisfactory.	The faculty was also advised to motivate the students to ask any queries (related to the topics of Optimization Methods) at any time of their BE program in physical mode. In addition to that the complete E-content of the course will be made available to the students for their future reference.

Action Taken Report (ATR) of Basics of Material Science (UES401)		
Assessment Year: 2021–2022 Subject Name: Basics of Material Science Subject Code: UES401 Name of Teacher submitting the ATR: Dr. Bhaskar Chandra Mohanty		
S No.	**Reasons for low attainment of CO**	**Actions taken for improvement**
1.	Major portion of CO1 was covered in tutorial classes.	This portion is now taught both in tutorial and lecture classes.
2.	This CO involves practice problems which are covered in tutorial classes where students get limited time to practice them.	Additional set of practice problems will be provided to students as home work for better practice.
3.	This portion was covered as last unit immediately prior to the end semester examination. Students were not able to practice related problems due to scarcity of time.	This portion will be covered in class well before the end semester examination so that students will get sufficient time to study and practice related problems.

Action Taken Report (ATR) of Numerical Analysis (UMA011)		
Assessment Year: 2021-2022 Subject Name: Numerical Analysis Subject Code: UMA011 Name of the Teacher submitting the ATR: Dr. Meenu Rani, Dr. Paramjeet Singh		
S. No.	**Reasons for low attainment of CO**	**Actions taken for improvement**
1.	CO3 is related to solving linear system and eigen-values. Earlier we had a feeling that student is familiar with linear equations but during the lectures, it was observed that students require some prerequisite knowledge of linear algebra, and they are not completely acquainted with it. Moreover, even though students feel they have understood the numerical problems, due to a lack of practice, they perform poorly and make many calculation mistakes, leading to different results and low scores. There are also lateral entry students who enroll directly in second year and don't have solid foundation in mathematics.	It was planned to give at least one lecture on the basics of system of equations and eigen-values. Also, we have included engineering-based problems in MATLAB. The students are also advised to solve more problems for practice. The instructors are also advised to motivate the lateral entry students during the class and advised to guide them after the class.
2.	CO4 is related to interpolation. We have observed that the topic was completely different for the students. Also, the topic was covered immediately after the mid-term examination and students are not much active immediately after the exams. The numerical problems in the topic are not much difficult but require more practice and high-speed calculations. We observed that the students don't practice to solve the numerical problem by hand. They just rely to have a look on the solved problems.	We advised the students to practice more by solving the exercises. The instructors were also advised to motivate the students to ask any queries during the lecture and after the class. It was also suggested to include a Tutorial in this course. As this topic was bit difficult to grasp, the instructors are advised to spend more time on the basics of polynomials.

Action Taken Report (ATR) of Mechanical Engineering Materials (UME516)		
Assessment Year: 2021–2022 Subject Name: Mechanical Engineering Materials Subject Code: UME516 Name of Teacher submitting the ATR: Dr. Tarun Nanda		
S.No.	**Reasons for low attainment of CO**	**Actions taken for improvement**
1.	Lecture slides (ppts) as well as pre-recorded video sessions (especially for concepts like microstructure evolution, structure-property relationship, thermomechanical treatment, and selection of suitable heat treatment/case treatment for a particular industrial application) should have been provided to the students before these topics were taken up in the lecture class for better understanding of concepts.	**A1.** Matter related to course contents in the form of lecture slides (ppts) as well as pre-recorded video sessions (especially for concepts like microstructure evolution, structure-property relationship, thermomechanical treatment, and selection of suitable heat treatment/case treatment for a particular industrial application) will be provided to the students before these topics are taken up in the lecture class for better understanding of concepts. **A2.** Case based industrial problems pertaining to topics of heat treatment, new thermomechanical processing routes etc. shall be taken up in the lecture classes. Also, latest materials like DP steels, TRIP steels, TWIP steels, CP steels will be discussed to make the students appreciate the importance and applications of this subject in the automobile industry.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO2	**2.10**	**2.12**	For PO2, the target level has been achieved. A total of 35 subjects were considered for calculating the attainment level of PO2. There was scope for further improvement as contribution of a few subjects towards attainment of this program objective were observed to be low. The subjects which needed improvement included UCB008, UEE001, UMA034, UMA011, UME404, UME515, UME516, UME807 and UME805. Out of these subjects, UCB008, UEE001, UMA011, UME404, UME515, UME516, UME807 and UME805 had high weightage (shown in the course-PO mapping) towards PO2. Thus, the attainment level of PO2 can be further improved by taking actions to improve the attainment level of COs of UCB008, UEE001, UMA011, UME404, UME515, UME516, UME807 and UME805. The observations and actions are as follows:

ATRs of the courses UME807, UEE001, UCB008, UMA011, UME404 and UME516 have already been provided in PO1 whereas the same for the courses UME515 and UME805 are as follows:

Action Taken Report (ATR) of Industrial Engineering (UME515)

Assessment Year: 2021–2022
Subject Name: Industrial Engineering
Subject Code: UME515
Name of Teacher submitting the ATR: Dr. Deepak Jain

S.No.	Reasons for low attainment of CO	Actions taken for improvement
1.	The course involved several mathematical concepts such as statistics, sampling techniques etc. to solve the numerical problems pertaining to most of the topics under the curriculum. Some students may have struggled due to a weak foundation in the related courses.	To address the problem, the students will be given extra sessions to develop their understanding of pre-requisites on the related mathematical topics especially during the tutorial classes.

Action Taken Report (ATR) of Robotics Engineering (UME805)

Assessment Year: 2021–2022
Subject Name: Robotics Engineering
Subject Code: UME805
Name of Teacher submitting the ATR: Dr. Jay Prakash Tripathi

S.No.	Reasons for low attainment of CO	Actions taken for improvement
1.	Complex mathematical concepts in kinematics, dynamics, and sensor fusion are challenging.	To include some additional mathematical questions in tutorial sessions and integrate it with the applications of the same in robotics, and provide step-by-step problem-solving guides. It is also planned to add more practice hours in the lecture classes.
2.	Limited access to robotics hardware and equipment for hands-on learning. Another strong reason why students struggle is to integrate knowledge from various disciplines like mechanics, electronics, and computer science.	1. Add some weightage of hands-on experience in the project assignment using the equipment available in mechatronics lab. 2. Experiential Learning center of TIET Patiala could also play a vital role in CO improvement if some activities are integrated with this course.

PO3: 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.

PO3	**2.10**	**2.41**	For PO3, the achieved level was good. A total of 24 subjects were considered for calculating the attainment level of PO3. To further improve the PO3 attainment level, the following subjects needed improvement: UME516, UEN002 and UME807. All of these subjects, had high weightage (shown in the course-PO mapping) towards PO3. To improve the attainment level of COs of UME516, UEN002 and UME807, the observations and actions are as follows:

ATRs of the courses UME807 and UME516 have already been provided in PO1.

Action Taken Report (ATR) of Energy and Environment (UEN002)

Assessment Year: 2021–2022
Subject Name: Energy and Environment
Subject Code: UEN002
Name of Teacher submitting the ATR: Prof. Amit Dhir

S.No.	Reasons for low attainment of CO	Actions taken for improvement
1.	Sustainable development involves a wide range of disciplines like economics, ecology, and policy-making, making it challenging for students to grasp the holistic nature of the topic.	**A1.** Workshops shall be organized which shall be aimed at highlighting the interconnectedness of disciplines in sustainable development, thereby assisting students in grasping the comprehensive approach. **A2.** Practical case studies will be seamlessly integrated to showcase the application of sustainable development concepts across diverse scenarios, enhancing their understanding of practical implementations.
2.	Abstract concepts like dispersion modeling, pollutant fate, and contaminant transport can be difficult to visualize and comprehend.	**A1.** Scaffolded Learning shall be implemented. This will help in building a progression of lessons that starts with simpler concepts before gradually introducing more complex ideas, helping students build a strong foundation. **A2.** Use of visual aids such as diagrams, flowcharts, animations, and simulations to visually represent complex processes, making them easier to understand and remember shall be implemented
3.	Understanding the environmental impacts of conventional energy sources can be challenging to comprehend fully. Besides the fast-paced evolution of energy technologies necessitates constant updates to course content to stay relevant.	**A1.** In the future, the faculty will relate course concepts to current news and events, demonstrating how energy decisions impact real-world situations. **A2**. Incorporation of discussions on the ethical dimensions of energy choices and their consequences for ecosystems and society, thereby fostering a deeper understanding of the broader implications of energy-related decisions shall be done.

PO4: 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.

PO4	**2.10**	**2.48**	For PO4, the target level was achieved. A total of 14 subjects were considered for calculating the attainment level of PO4. Though the attainment level was better than the set target, but there was scope for further improvement in course of UME516 and UME807 as these courses had shown low CO attainment levels. To improve the attainment level of COs of UME516 and UME807, the observations and actions are as follows:

ATRs of the courses UME516 and UME807 have already been provided in PO1.

PO5: 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.

PO5	**2.10**	**2.43**	For PO5, the attainment level was well above the target level. A total of 17 subjects were considered for calculating the attainment level of PO5. Moreover, all the CO scores were also found to be satisfactory.

PO6: 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.

PO6	**2.10**	**2.11**	For PO6, the target level has been achieved. The score was calculated using 09 subjects. Out of these 09 courses, COs scores for four courses were observed to be low. These included UCB008, UEN002, UME511 and UME502. Out of these four courses, UME511 and UME502 had shown high weightage (shown in the course-PO mapping) towards PO6.

ATRs of the courses UME511 and UME502 had already been provided in PO1.

PO7: 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.

PO7	**2.10**	**2.15**	For PO7, the score was calculated using 10 subjects. The attainment level was more than the target level. However, for certain courses, COs scores were observed to be low. These included UCB008, UEN002, UME502 and UME511. Out of these four courses, UEN002, UME502 and UME511 had shown high weightage (shown in the course-PO mapping) towards PO7, and so these courses required improvement.

ATRs of the courses UEN002, UME502 and UME511 have already been provided in PO3 and PO1 respectively.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO8	**2.10**	**2.74**	For PO8, the score was calculated using 05 subjects. The attainment level was little above the target level. All CO scores were also found to be satisfactory.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO9	**2.10**	**2.55**	For PO9, the target level was achieved. A total of 16 subjects were considered for calculating the attainment level of PO9. It was found that CO scores for the subjects of UME404 and UTA026 were low. Both these subjects had high weightage (shown in the course-PO mapping) towards PO9 which required improvement.

ATR for UME404 has already been provided in PO1 whereas ATR for UTA026 has been provided as follows:

Action Taken Report (ATR) of Manufacturing Processes (UTA026)

Assessment Year: 2021–2022
Subject Name: Manufacturing Processes
Subject Code: UTA026
Name of Teacher submitting the ATR: Dr. Dheeraj Gupta

Reasons for low attainment of CO	**Actions taken for improvement**
PO9 is related to the team work. Due to the ongoing pandemic situation during that session (2021-22), students were not expected to work in the groups. Hence, individual assessment was taken for each student and many online quizzes were conducted as per the evaluation scheme decided by Dean of Academic Affairs (DoAA). This subject demands a hands-on experience, which is only possible, if students come to workshop and do the workshop practice in groups. Owing to this situation, the group activity was not carried out by the students.	Next time onwards the students will be called for hands-on practice in the workshop as a standard routine/practice and will be evaluated accordingly.

PO10: 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.

PO10	**2.10**	**2.58**	For PO10, the target level was achieved. A total of 15 subjects were considered for calculating the attainment level of PO10. For two courses i.e., UME404 and UME805, CO scores were observed to be low. Both these courses had high weightage (shown in the course-PO mapping) towards PO10 which required improvement.

The observations and actions pertaining to UME404 and UME805 have already been explained in PO1 and PO2 respectively.

PO11: 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.			
PO11	**2.10**	**2.62**	A total of 09 subjects were considered for calculating the attainment level of PO11. The target level has been achieved. Moreover, all the CO scores were also found to be satisfactory.
PO12: 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.			
PO12	**2.10**	**2.34**	For PO12, the target level was achieved. A total of 16 subjects were considered for calculating the attainment level of PO12. Though the attainment level was better than the set target, but there was scope for further improvement as contribution of three subjects (UCB008, UMA011 and UME404) towards attainment of this program objective was observed to be low. Out of these three courses, UCB008 and UME404 had shown low CO attainment levels as well as had high weightage (shown in the course-PO mapping) towards PO12.
The observations/actions for UCB008 and UME404 have already been explained in PO1.			
PSO1. Core competency: Design, compose, evaluate, review, report, direct, and supervise the application of electro-mechanical principles to meet the needs of the society to safeguard life, health, property and societal welfare.			
PSO1	**2.10**	**2.37**	For PSO1, the target level was achieved. A total of 28 subjects were considered for calculating the attainment level of PSO1. The subjects with low CO score included UME516, UME807, UME404 and UME805. All the four subjects had shown high weightage (shown in the course-PO mapping) towards PSO1.
The observations/actions for UME516, UME807 and UME404 have already been explained in PO1. The observations/actions for UME805 are provided in PO2.			
PSO2. Practical competency: Ability to implement and integrate electronic, mechanical, electromechanical, control and computer systems that contain software and hardware components, including sensors, actuators and controllers.			
PSO2	**2.10**	**2.38**	For PSO2, the target level was achieved. A total of 23 subjects were considered for calculating the attainment level of PSO2. The subjects which needed improvement included UME404, UME515, UME807, and UME805. All these subjects had shown low CO attainment levels. Out of these only UME515 had high weightage (shown in the course-PO mapping) towards PSO2 and needed improvement. The observations/actions for UME515 have already been explained in PO2.

1.5 Academic Audit and actions taken thereof during the period of Assessment

Internal Quality Assurance Cell (IQAC) contributes significantly for institutionalizing the quality assurance strategies and processes. The institute has established, documented, and implemented a Quality Management System under the aegis of IQAC. Continuous improvement in the implementation and effectiveness of the quality management system is ensured through continuous reviews of the IQAC cell. The institute improves the effectiveness of quality management system through use of quality policy, audit results, analysis of data, corrective and preventive actions, and management review. The IQAC has mandated that we conduct frequent Academic Reviews of engineering departments at TIET.

1. Procedure for Curriculum Design and Development

The statutory bodies of the Institute and department committees, the Department Planning and Policy Committee (DPPC), Department Academic Affairs Committee (DAAC), Board of Studies (BoS), Senate Undergraduate Committee (SUGC), and the Senate oversee the design and development process so that activities are carried out in a planned manner. The detailed planning for curriculum design and development is the responsibility of the Head of Department (HOD). The process generally begins with a need analysis report which comprises of customer needs, overall goals of Instructions, Regulatory guidelines, and general characteristics of target population. The curriculum design and development for all programs is done at least once every four years to ensure continuing suitability, adequacy and effectiveness in satisfying the requirements and the vision, mission and quality policy of the institute. The design process includes assessing opportunities for improvement and the need for ensuring suitable employability, innovation and research. The process invites formal inputs from all stake holders and generally includes sources viz. (a) Action taken reports on the previous reviews and external accreditation reports (NAAC, NBA-AICTE, ABET), (b) Results of student's performance in various examinations, (c) Result of Students Reaction Survey, (d) Feedback from Industry, Alumni, participating organizations in campus placements, (e) Review of mission and quality policy.

Reviews are conducted at defined stages of the curriculum design, in which faculty members from the concerned area as well as experts from amongst the peer group from within and/or outside the Institute are associated. Curriculum design and development involves the following steps:

- **Main Inputs: Curriculum Design, Development, and Revision**

The design and development process generally begins with a need analysis report which comprises of (i) Stated needs (ii) Implied needs (iii) Overall goals of Instructions (iv) Relevant standards i.e. AICTE and UGC guidelines and Curricula of Entrance Tests like Indian Engineering Services (IES) and Graduate Aptitude Test for Engineers (GATE), etc. and (v) General characteristics of target population. Organizational and Technical interfaces between different faculty and external expert groups providing inputs to the instructional design are defined, committees are constituted and their reports are documented. Faculty members from different disciplines connected with the design & development activity are associated with the process. The updating/restructuring is carried out as the design process progresses. Clear responsibilities are assigned and effective communication is ensured. The requirements of instructional design are determined and recorded. For instructional design, the input is taken from various sources. Input requirements are clearly understood and reconciled. The design input may come from:

- Need analysis & Reviews.
- Recommendations from
  - Faculty & senior management
  - Employers and industry
  - Alumni

- Regulatory Bodies
- Success/failure reports of similar courses & programs.
- Published literature relevant to programs.
- Boundary condition w.r.t GATE, IES, IAS curricula etc.

The curriculum revision of the existing programs is carried out at least once every four years to ensure continuing suitability, adequacy and effectiveness in satisfying the requirements and the vision, mission and quality policy of the institute. The revision process includes assessing opportunities for improvement and the need for ensuring employability, innovation, research and higher education. The process invites formal inputs from all stake holders and generally includes the following sources:

- **Action taken report on the previous reviews and external accreditation reports (NAAC, NBA-AICTE)**
- **Results of students' performance in various examinations**
- **Result of Students Reaction Survey**
- **Feedback from**
- **Industry,**
- **Alumni,**
- **participating organizations in campus placement and other concerned sources**
- **Details of corrective/preventive actions**
- **Improvement programs suggested/recommended**
- **Training programs launched**
- **Review of mission and quality policy**

The process of curriculum design, development, and revision is monitored by the following committees:

A. Process is initiated by Department Planning and Policy Committee (DPPC)

DPPC conducts monthly meetings to consider any proposal related to students, faculty, any academic matter, or any other aspect of functioning of the department. Decisions are taken by the committee and its recommendations are implemented in a specified time frame. Recommendations related to academic decisions are sent further to BOS or Deans of the institute, as the case may be.

B. Inputs by Department Academic Affairs Committee (DAAC)

DAAC initiates the decision process regarding curriculum and other academic matters by considering feedback from various stakeholders.

C. Design and review by Board of Studies (BoS)

Recommendation of DAAC and DPPC for curriculum revision are discussed in the meetings of Board of Studies. The recommendations of BOS are forwarded to SUGC and SGPC for further consideration.

D. Review by Senate Undergraduate Committee (SUGC)

SUGC is the institute level body for UG programs which further reviews the recommendations of Board of Studies of various departments and recommends to the Senate for approval.

E. Approval by Senate

Senate is the highest academic body of the institute which reviews recommendations of SUGC and accord its approval.

F. Ratification by Board of Governors (BoG)

BOG provide its final approval to all academic and non-academic matters for implementation in the institute.

- **Main Outputs: Curriculum Design And Development**

The output of instructional design & development is documented in the form of a report named **"Curriculum and Scheme of Courses".** The design output report includes:

- **Program Educational Objectives; Student Outcomes**

- **Scheme of Courses and the Detailed Syllabi**
- **Assessment and Evaluation Scheme**
- **Course Outcomes**

2. Assessment and Audit Tools

The following assessments/audits are used in the academic system to ensure continuous improvement:

A. ISO Audits: These audits are conducted to check academic record keeping (course files, student activities, maintenance of laboratory records etc.) and standard operating procedures (if any). The detail of documents contained in the course file are as follows:

LIST OF DOCUMENTS TO BE ATTACHED IN COURSE FILE

Name of the Course:

Course Code:

Session:

Semester:

(PLEASE TICK THE CHECK BOX WHATEVER IS APPLICABLE)

1.	PEO's, PO's and PSO's of the respective program	
2.	List of registered students	
3.	Course syllabus	
4.	Course blow-up	
5.	Copy of instructor time table	
6.	Evaluation Scheme (Rubrics to be added)	
7.	Attendance record till MST with list of short attendance students	
8.	Attendance record till EST with list of short attendance students	
9.	Tutorial sheets/ assignments/ seminar topics	
10.	List of experiments	
11.	Quizzes question paper with solutions	
12.	Marks in Quizzes	
13.	MST question paper with rubrics of the evaluation	
14.	Marks in MST	
15.	MST answer sheets for best, average and poor performance	
16.	Marks in Tutorial/ Assignments/ Seminar/ Lab evaluation (to be attached separately.)	
17.	Ongoing performance record (till EST)	
18.	EST question paper with rubrics of the evaluation	
19.	Notice to see evaluated EST sheets to be printed on EST question paper	
20.	EST answer sheets for best, average and poor performance	
21.	EST Marks	
22.	Final performance of students	
23.	Grade sheet	
24.	Course delivery forms with mapping to CLO	
25.	Measurement of outcomes (as per the attributes to be measured for the course)	
26.	Reflection	
27.	Course Coverage Performa	

ature of the Course Coordinator
Name of Course Coordinator

These items are arranged in reverse chronological order in the course file.

B. Board of Examination (BoE) is an academic body of the institute comprising of Dean of Academic Affairs (DoAA,), Controller of Examinations (CoE) Associate Dean (Academics), and Head of Departments/Schools (HoD/HoS). BoE happens once in a semester, after the EST evaluations and initial grades awarded by the respective course coordinators. Primary function of BoE is to review the

grade limits, cross checking of evaluated answer sheets, internal evaluations conducted and results of course outcomes. Table 1.5a presents the details of various audits/reviews and the recommendations.

Table 1.5a Academic Audit and actions taken thereof during the period of Assessment

S. No.	Audit/Review Dates	Activity	Remarks/Concerns/Recommendations/Actions Proposed
1.	31st Jul 2020 31st Aug 2020 29th Sept 2020 27th Oct 2020 26th Nov 2020 04th Dec 2020 29th Jan 2021 05th Feb 2021 30th Mar 2021 27th Apr 2021 31st May 2021 29th Jun 2021	DPPC	➢ Detailed information about DPPC should be made available on the department website so that the students (PG and UG students) can send their concerns. ➢ Include two Assistant Professors and two students in the DPPC to prepare and review the long term and short term goals and objectives of the department. ➢ To carry out a bench marking exercise for MED by comparing its performance with other reputed institutes (to be completed in next three months). ➢ Additional guidelines to execute the Capstone Project effectively and efficiently ➢ Course credit revision ➢ Guidelines for the remote internship (online internship) ➢ Recommendations for project semester during the pandemic ➢ Revised 2021 MEE scheme with inclusion of 3 Minor Areas
2.	12th Mar 2021	ISO	➢ Documents in order.
3.	29th Dec 2020 15th Mar 2021 24-25th Mar 2021 02nd Aug 2021	BOE	eviewed the grade limits, cross checked the evaluated answer sheets.
4.	17th Aug 2021	ISO	➢ ISO documents in order.
5.	13th Jul 2021 13th Aug 2021 23rd Sept 2021 28th Oct 2021 26th Nov 2021 24th Dec 2021 27th Jan 2022 28th Feb 2022 28th Apr 2022	DPPC	➢ Teaching load and time table discussed and approved ➢ Credits and loading of 'Capstone Project' (UMT893) revised ➢ DAAC for Capstone (Product Development) and Capstone (Research) ➢ Minors for 2020 scheme (implementation of minors) ➢ Discussion on Research space ➢ Shortlisting of program coordinator for MED ➢ Regarding existing PEOs ➢ Proposal of technical staff for Mechatronics Lab. ➢ Proposal of trained technical staff in Additive Manufacturing Lab. ➢ Adding an open elective subject on Hydrogen Fuel Cell Technology, both at UG and PG level ➢ Feasibility check of shifting project semester from sixth semester to fifth semester. ➢ Presentation of Minutes of meeting of Risk Analysis Committee ➢ Regarding procurement of GAIT Lab under FIST funding.
6.	1st Jan 2022 28th Jan 2022	BOE	Reviewed the grade limits, cross checked the evaluated answer sheets.
7.	06th May 2022	DAAC	➢ Revisions to the course of System Modelling and Simulation (UME722) for minor corrections in objectives and contents in the syllabus. Also, one CLO deleted and another was added.
8.	12th May 2022	BOS	➢ **Revisions to the course of System Modelling and Simulation (UME722) for minor corrections in objectives and contents in the syllabus. Also, one CLO deleted and another was added.**
9.	17th May 2022	SUGC	➢ Considered the revisions in the syllabi of courses offered to BE-MEE program students (as discussed in DAAC and BOS) and recommended the same to the Senate for approval. ➢ Considered the revisions in the syllabi of courses offered to BE-MEC program students (as discussed in DAAC and BOS) and recommended the same to Senate for approval.
10.	18th May 2022	ISO	➢ Course files found in order by Internal ISO auditor ➢ Other ISO documents also in order; no actions were needed

11.	15th June 2022	BOE	Reviewed the grade limits, cross checked the evaluated answer sheets.
12.	16th May 2022 13th June 2022 28th July 2022 26th August 2022 30th Oct 2022 30th Nov 2022 9th Dec 2022 3rd Feb 2023 28th Feb 2023 28th Mar 2023 1st May 2023 30th May 2023 13th June 2023	DPPC	➢ Approval of teaching load for the Semester commencing in July 2022 ➢ Considered the teaching load reduction requested by Dr. Vineet Srivastava ➢ Technical report writing suggestions considered by DAAC ➢ Choice of subjects (preferences being filled in by the faculty) for the teaching load discussed ➢ Load calculations during the subject allotment by considering the number of students registered were also discussed ➢ To modify the evaluation scheme of the Project semester. ➢ Revision of the list of documents required in the course files after incorporating the feedback received from ISO Audit and a recent NBA visit ➢ Approval of teaching load for the Semester commencing in Jan 2023 ➢ To revise course objective and scope of the Project Semester ➢ To make the project semester flexible ➢ Finalization of PSO's for Mechanical Engineering course ➢ Approval of teaching load for the Semester commencing in July 2023 ➢ To discuss the admission scenario and actions required
13.	28th Dec 2022 30th Jan 2023	BOE	➢ Reviewed the grade limits, cross checked the evaluated answer sheets.

14.	14th Feb 2023 15th Feb 2023 16th Feb 2023 17th Feb 2023	DAAC	➢ **Revisions to the course Engineering Fluid Mechanics (UME307) proposed by Prof. S. S. Mallick.** • **Presently this course has LTP distribution of 3-1-0. Prof. Mallick proposed that this course should have Lab component (to be held in alternate weeks). He also proposed to remove some contents from the existing syllabus. So, the revised LTP of this course, as proposed by him, would be 2-1-2*.** • He shared the revised syllabus for consideration in the upcoming BoS meeting. ➢ **A new elective course titled, 'Gas Turbine Theory and Design' (as Elective IV in Semester 8) was proposed by Mr. Sumeet Sharma. He has shared the syllabus of this new course for consideration in the upcoming BoS meeting.** ➢ It was pointed out in the DAAC meeting that an elective course titled Gas Dynamics and TurboMachines (UME807) was removed in the last year BoS meeting, whereas it is still mentioned in the course scheme. Needful correction to be done. ➢ The courses Refrigeration and Air Conditioning (UME719) of 7th semester and Fluid machines (UME723) of 8th semester should be swapped. There are two reasons for this swapping as given below: • A new elective course titled Gas Turbine Theory and Design is proposed to be introduced in the 8th semester. This course is a design based course on gas turbine and the fundamental course on gas turbine is Fluid Machines which is also in the 8th semester. Thus the DAAC meeting members were of the opinion that the Fluid Machines should be in the 7th sem and Gas Turbine Theory and Design should be in the following sem (8th sem). • The course Heat Transfer (UME720) is the prerequisite course for Refrigeration and Air Conditioning (UME719). Both are in 7th semester. Hence Refrigeration and Air Conditioning (UME719) should be moved to 8th sem. ➢ **Renaming of the elective course title from Fuel Cell Technology (UME727) to Hydrogen Fuel Cell Technology was proposed by Dr. Amandeep Singh Oberoi. Course content and CLOs will remain the same.** ➢ Minor modifications in the CLO statements of the course Heat Transfer (UME720) were proposed by Dr. Madhup Mittal. He has shared the revised CLO statements for consideration in the upcoming BoS meeting. ➢ Revisions to the course **Solar Energy Engineering (UME853) proposed by Dr Madhup Mittal.** • A new unit titled Evacuated Tube Collector (ETC) is added in the syllabus • The title of the unit, 'Design of flat plate collectors' is changed to 'Flat plate collectors'. Similarly, the title of the unit 'Design of concentrating collectors' is changed to 'Concentrating collectors'. • CLO statements are modified. • He has shared the revised syllabus and revised CLO statements for consideration in the upcoming BoS meeting. ➢ Revision to the course UTA026 (Manufacturing Processes) to include manufacturing processes for both mechanical and electronics, including the process of PCB manufacturing. ➢ **Since the Robotics lab was recently created in MED, therefore the LTP 310 of the course UME805: Robotics Engineering is to be changed to LTP302 with a laboratory component as suggested by Prof. T.K. Bera.**

			➢ **Revisions to the course Engineering Drawing (UTA015) proposed by Dr. Daljeet Singh and Dr. Sandeep Sharma** • The textbook and Auto-CAD software revision was proposed. • Minor corrections in the contents and assembly module were proposed with an updated evaluation scheme. ➢ Revision to the course Engineering Design Project-I (UTA016) proposed by Dr. A. S. Jawanda • New projects and/or new developments in the existing projects can be added. ➢ **Revision to the course Solids and Structures (UES017) proposed by Dr. Neeraj Grover** • **Impact and hardness tests can be included in the lab.** ➢ **Revision to the course Industrial Engineering (UME515) proposed by Dr. Jaskaran Singh** • **A new topic, "statistical methods for data analysis," can be brought under the existing topic, "quality control." Dr. Jaskaran will share the revised syllabus.** ➢ **Revision to the course Mechanics of Machines (UME308), Theory of Machines (UMT304), and Dynamics and Vibrations (UME513) proposed by Dr. Rajendra Godara, Dr. Gagandeep Bhardwaj and Dr. Ashish Purohit** • Graphical methods in the velocity and acceleration analysis are to be added in place of analysis using software tools. • **SDOF vibration systems overlap in the courses Mechanics of Machines (UME308) and Dynamics and Vibrations (UME513), so the topic is to be deleted from the course courses Mechanics of Machines (UME308)** • It was proposed to shift D'Alembert theorm to the course Mechanics (UES009) from Dynamics and Vibrations (UME513) • A detailed review of these courses was suggested. Dr. Rajendra Godara, Dr. Gagandeep Bhardwaj, and Dr. Ashish Purohit will share the revised syllabus of these courses. ➢ **The course objective/syllabus and CLO of the subject Manufacturing Processes (UTA026) has been modified for semester III.** ➢ **The course objective/syllabus and CLO of the subject Manufacturing Technology (UME509) has been modified for semester V.** ➢ **It was proposed to shift the course "Additive Manufacturing" from elective basket to VIII semester core course.**

15.	7th Mar 2023	BOS	➢ The course Manufacturing Processes is brought in Semester-II from Semester-III. The course Mechanics is shifted to Semester-III from Semester-II. The course "Engineering Design Project-I" is shifted to Semester-IV from Semester-II. ➢ LTP of the course Theory of Machines is reduced from 312 to 212 and accordingly syllabus has been revised. ➢ The course UME517: Materials Engineering and Metallurgy with LTP 210 is brought from Semester-IV instead of UES012: Engineering Materials (LTP:312) along with the UG Mechanical Engineering. ➢ LTP of the course Computer aided Design & Analysis is reduced from 323 to 304, ➢ LTP of the course UME722: System Modelling and Simulation is changed from 310 to 212 and accordingly the syllabus has been revised with the addition of lab components ➢ The professional "ELECTIVE - IV" and "ELECTIVE-V" are brought to Semester-VII from Semester-VIII. ➢ The CAPSTONE PROJECT (ENDS) is brought to Semester-VII from Semester-VIII and it will be completed either in Semester-VII or Semester-VIII. ➢ The students who opt the project semester internship in Semester- VII, they will complete the CAPSTONE PROJECT in Semester-VIII otherwise in Semester-VII. ➢ Introduction of new course scheme for 2023 to allow for the new mandate of common courses for 1st and 2nd semester as proposed by DoAA were explained to BoS members. The BoS members agreed to the changes proposed for 2023 scheme. It was emphasized that Choice Based Credit System (CBCS) should be introduced in the coming years. ➢ In accordance to the new guidelines proposed by DoAA office the no. of credits should be in the range 160−165. In the present scheme the no. of credits are 178.5, To reduce the academic load it is proposed that the no. of credits should be reduced to 166.0. For this purpose there are some changes to LTP of a some courses mentioned in point 5 in the news scheme 2023 onwards. ➢ To allow for projects semester in 7th or 8th semester, an updated course scheme from 6th semester onwards as a one-time measure for 2021 and 2022 of Mechanical engineering was explained. The BoS members were explained the significance of project semester for the students placements. The course scheme for 2021 and 2022 will be updated and it will be floated as one time measure. ➢ As a similar course as per the requirements of Mechanical engineering there is already existing course with title “Materials Engineering and Metallurgy” (UME517) and is being taught in 5th semester. It has been decided to propose to remove the course title “Basics of Materials Science” (UES401). Further UME517 is shifted from 5th semester to 3rd semester to fulfill the pre-requisites on Material Science knowledge for 2023 and onwards scheme. ➢ Some minor revisions to the following courses, CLOs, and Credits was explained by individual faculty members: • UME722 by Prof. T K Bera • UTA015, UES017, UME308, UME513 by the UG Coordinator • UME509, UTA026, and UME517 by Dr. Vineet Srivastava • UME307 by Prof. S S Mallick • UME720, and UME853 by Dr. Madhup Mittal The BoS members were explained the rationale behind these changes. The changes were accepted with minor revisions.

			➢ **A new course as Elective III or IV title "Gas Turbine Theory and Design" was also proposed by Dr. Madhup Mittal which was also recommended by the BoS, it will be floated from 2023 onwards scheme**.
16.	10th Mar 2023	SUGC	➢ Engineering Design Project – I and Engineering Design Project – II should be renamed to the department specific project courses so that the same can be differentiated from the existing EDP-I and EDP-II subjects. ➢ Course "Humanities for Engineers" in the scheme of BE-ELE, EIC, EEC should be in the 3rd or 4th year.
17.	5th June 2023	BOE	➢ Reviewed the grade limits, cross checked the evaluated answer sheets.
18.	3rd Mar 2023	ISO	➢ All the ISO documents of the Mechanical Engineering Department (regarding Risk assessment register, Minutes of DPPC, maintenance records of Lab, Course coverage performa, notification of online lectures to the students, record of course scheme revision, record of surprise check by HMED, Course files, lab record, student project reports, PhD file, etc.) are in order; no actions were needed.

Program Outcomes once mapped to the learning outcomes of a particular course gives us an insight of the level of achievement of students in that particular PO. Given this broaden picture of new understanding, we get an opportunity to improvise through initiatives and also implement certain changes that can be lead us to have better performances. For example, in an outcome measurement related to ability to identify and formulate problems for engineering system was assessed through courses that basically require an understanding of engineering problems and its formulation which may lead to problem solving. Therefore in order to further strengthen student learning, we implemented a paradigm shift in teaching from **Teacher Centric to Student Centric Learning Approach**. This concept was introduced to the faculty through **Centre for Academic Practices and Student Learning (CAPSL)** training workshop which started in year 2016. All faculty from the department have been completed the basic course of New Direction Program and benefitted through this workshop. Faculty was trained to adopt academic practices such as outcome based learning, creative thinking, introducing assessment methods involving students, and many more. With these approaches, students were more open to creatively formulate problem.

On the other hand, where student is assessed for his/her ability to solve complex engineering problems, role of problem solving through tutorials becomes very important. While student centric approach did help in 2018-2019 but a marginal fall was visible in 2019-2020. One of the main reasons for this can be attributed to a shift to an **Online Mode of Teaching because of COVID pandemic**. Many of the courses covered in this category were from odd semester such as Machine Design (UME832), Solids and Structures (UES017), Mechanics o Machines (UME308) i.e Jul-Dec, 2020. Faculty was still in a learning mode to teach online and conduct tutorials. Lecture/Tutorial sessions needed to be channelized in less time. As a result, **Thapar Learning Management System (TIET-LMS)** was developed and effective July 2020, all academic activities are conducted through it, and reviewing tutorials has also now become seamless. It is anticipated that with the coming up of TIET-LMS, we foresee a positive improvement in this regard in the future.

We strongly believe that a static curriculum cannot bring in changes in the understanding and applying engineering design to produce solutions in the context of global, cultural, social, environmental and economic factors. Keeping this in view, our scheme and syllabi are updated from time to time. The board of Studies (BOS) meeting is held on a regular basis wherein an expert opinion is sought from Industry and Academic experts in the field of mechanical engineering. Based on their suggestions, curriculum is modified and updated to match with the latest market trends. The scheme is then sent to the Senate for approval. One of the recent and

major changes that we have incorporated in our Curriculum includes:

- Keeping the prospects of today's competitive job market in mind, three focus areas have been offered to B.E. Mechanical Engineering students admitted in 2019 onwards after the end of Second Year. Three focused electives/electives are being given in the curriculum in order to enhance student's skillset in a specialized field. A focused elective/electives will add another dimension to student's professional knowledge. If any student wishes to be specialized in a specific focused area (A/B/C), student has to remain in that particular area till the completion of all the specified courses of that area.

A. Automotive Technologies

A1. Vehicle Dynamics

A2. Automotive Mechatronics

A3. Electric and Hybrid Vehicles

B. Robotics

B1. Robotics Engineering

B2. Robot Dynamics and Control

B3. IoT and Machine Learning in Robotics

C. Industry 4.0

C1. Additive Manufacturing

C2. Industry 4.0 Complaint Product Design

C3. Industrial IoT and Machine Learning

- Another major revisions to the curriculum are already mentioned in Table 1.5 a

Over the past three years, particularly, we are laying **more stress on writing and presentation skills**. Casual, unprofessional writing is no more accepted in project report, capstone, or laboratory reports etc. This is keeping in view the need to communicate effectively with range of audiences through writing, with peers and with people in professional organizations. Now Students have to undertake several proof reading before the final report is accepted for evaluation purposes. Several templates of project writing have been prepared by the faculty and are circulated to students much before the submission time. Students are encouraged to read research papers and asked to bring in a small write up, which becomes useful in undertaking a Capstone Project (UME 793). Students who go for project semester are exclusively judged for their writing and communications skills by their Industrial Mentor, which in itself is a motivation for students to work harder even when outside the campus. The **Centre for Training & Development (CTD) on campus** has been established to build upon the communication skills through lecture series, workshops and several other activities. We do see several benefits emanating from this Centre and we expect that a positive change will be

reflected in the PO score over the next few years.

We have managed to continuously improve in our outcomes related to experimentation, analyzing and interpreting data for making informed engineering judgments. **Experiential Learning Centre (ELC)** activities have been introduced recently and at very early stage in the curriculum. Several activities have been accomplished successfully as ELC activities in the last 2 years such as:

- **Dissection of mountain bicycle and Engineering Design Challenge**
- **Dissection of internal combustion engine and automobile transmission**
- **Design of a pneumatically actuated chair testing machine**
- **Design and testing of a CNC machine tool drive and control system**
- **Design and testing of a custom plate type heat exchanger**

Many more such Experiential activities are lined up for all Ist –IIIrd Year BE Mechanical Engineering students to give them Hands-On-Training as well as experience of real life field problems and applications. Few glimpses of the experiential learning centre events held at MED are shown in **Fig 1-5**. These activities do not contribute to the total credits earned, rather are an initiative to inculcate team spirit and make students learn to design, fabricate and commission a real world problem while working in a team. This puts the students in a practice to do more similar projects (e.g. Capstone project, group design project, project semester) in their latter part of the curriculum.

Fig. 1: Students involved in bicycle and Engineering Design Challenge

Fig. 2: Students involved in internal combustion engine and automobile transmission

Fig. 3: Students involved in pneumatically actuated chair testing machine

Fig. 4: Students involved in CNC machine tool drive and control system

Fig. 5: Students involved in design and testing of a custom plate type heat exchanger