Check List

1.	MOM
2	Ordinance
3.	Evaluation Scheme
4.	Syllabus
5.	Mooc
6.	Appendix-1 Appendix-2 Appendix-3

Minutes of Meeting
Bachelor of Technology
(Mechanical Engineering)

[Applicable w.e.f. Academic Session 2025-26 till Revised]

FACULTY OF ENGINEERING & TECHNOLOGY
COURSE STRUCTURE
RAMA UNIVERSITY, UTTAR PRADESH, KANPUR

Website: www.ramauniversity.ac.in

Ref: RU/FET/ME/BOS/2025/001

Dated: 01-Sept-2025

Faculty of Engineering & Technology
Department of Mechanical Engineering
Minutes of Meeting
Boards of Studies

A meeting of Boards of Studies of Mechanical Engineering (B. Tech.) held on 01-Sept-2025 in Dean Office. The following members were present:

1. Dr. Indrajeet Gupta - Chairperson
2. Dr. Narendra Kumar - Member
3. Dr. Deeksha Ranjan - Member
4. Mr. Rajneesh Kumar - Member
5. Mr. Saurabh Samaddar - Member

The following members agreed to review the minutes online meeting mode.

1. Prof. Satish C. Sharma - External Member

Agenda Items

1. **Proposed Change in the Scheme:**
   Review and approval of modifications in the academic scheme for upcoming sessions.
2. **Proposed Change in the Credits and Course Nomenclature:**
   Discussion on aligning course credits and titles as per updated academic and industry requirements.
3. **Proposed Change in Syllabi and Introduction of New Evaluation Scheme:**
   Examination and approval of revisions in existing syllabi to meet emerging technological trends.
   Introduction and implementation of a new evaluation scheme for better assessment of student learning.
4. **Incorporation of MOOCs in Syllabus:**
   Integration of Massive Open Online Courses (MOOCs) into the curriculum to enhance learning outcomes.
5. **Incorporation of Flipped Classroom Approach:**
   Adoption of flipped classroom methodology to improve student engagement and practical learning.
6. **Revision of External Examiner Panel:**
   Review and update of the panel of external examiners for various courses and programs.

The BOS committee confirmed the minutes of the BOS meeting held on 01-Sept-2025

1. **Action Taken Report (ATR) in Minutes of Previous Meeting:**
   The BOS Committee confirmed the minutes of the BoS meeting held on 28 July, 2023.
   The BOS Committee discussed on Action Taken Report on the basis of result analysis of session 2023-24 (Even) and 2024-25 (Odd Semester).
2. **To consider and approve new Evaluation Scheme and Syllabus:**

S. No.	Item No	Feedback from Faculty and Student	Action Taken / Remarks
I	**RU/FET/ME/BOS/2025/BTECH/001**	**Proposed Change in the Scheme** Students and faculty suggested revising the existing scheme to reduce redundancy, ensure better alignment with industry trends, and incorporate multidisciplinary flexibility as per NEP 2020.	The committee took the decision to revise the scheme under **R-25**, restructuring the curriculum to ensure flexibility, skill-based learning, and alignment with NEP 2020 provisions.

2	**RU/FET/ME/BOS/2025/BTECH/002**	**Proposed Change in the Credits and Course Nomenclature** Faculty emphasized rationalizing credits to balance workload; students requested clarity and uniformity in course titles to match industry standards.	The committee took the decision to rationalize credits as per **AICTE 2022 guidelines** and update course nomenclature to reflect industry relevance.
3	**RU/FET/ME/BOS/2025/BTECH/003**	**Proposed Change in Syllabi and Introduction of New Evaluation Scheme**	The committee reviewed and approved the R-25 Assessment Components, which are structured as: CA: 30 Marks, MTE: 20 Marks, and ETE: 50 Marks, Total 100 Marks. For Continuous Assessment (CA), the distribution will be: Attendance – 10 Marks, and Assignments/Quiz/Seminar/Term Paper/Certificate/Class Project – 20 Marks. The committee also resolved to update the syllabi by incorporating industry-oriented courses and emerging technologies, along with introducing a revised evaluation scheme that places greater emphasis on projects, assignments, and continuous assessment.
4	**RU/FET/ME/BOS/2025/BTECH/004** (In reference with Circular No: RU/DA/2025/020 Dated: 28 July 2025)	**Incorporation of MOOCs in Syllabus** Faculty and students requested flexibility to pursue online courses (SWAYAM, NPTEL, Coursera) for skill enhancement.	The committee took the decision to incorporate MOOCs in the curriculum, allowing credit transfer (up to 20%) as per **AICTE norms.**
5	**RU/FET/ME/BOS/2025/BTECH/005**	**Incorporation of Flipped Classroom Approach** Students preferred interactive and practice-oriented sessions; faculty supported blended learning to increase participation.	The committee took the decision to formally introduce the flipped classroom pedagogy and circulate guidelines to faculty for effective implementation.
6	**RU/FET/ME/BOS/2025/BTECH/006**	**Course Bucket Structure under R-25** Students and faculty suggested increasing elective choices and introducing structured specialization options.	The committee took the decision to approve the following bucket structure under **R-25**: • **Professional Elective Bucket – 24 Courses** • **Open Elective Bucket – 17 Courses**

3. **Revision of External Examiner Panel:** Faculty recommended updating the panel to include experts from both academia and industry.
   The committee took the decision to revise the external examiner panel, including **industry experts and academicians** from reputed institutions.
4. **Question Paper Format:** The question paper format, as per NAAC/NBA requirements, includes a dedicated column for CO (Course Outcome) mapping against each question. This ensures clear alignment of assessment items with defined learning outcomes, facilitates transparent evaluation, and supports accreditation compliance through measurable and outcome-based education practices.

5. It was clarified that the **R-25 curriculum and evaluation scheme shall be applicable only from the academic session 2025–26 onwards.** The students admitted in earlier sessions will continue to follow the curriculum and regulations approved under the previous BoS.
6. The experts suggested that these subject Industrial Tribology (MBEO-406) and Product design and Development (PME-6005) should be added in new curriculum.
7. **Any other issue with the permission of the Chair**: The meeting concluded with a vote of thanks to the chair.

Date of the Next Meeting: to be decided and conveyed later

Chairperson

Signature: .....

Name: Dr. Indrajeet Gupta

Date:

Internal Members

Signature: 1..... 2..... 3.....

Name: Dr. Narendra Kumar Name: Dr. Deeksha Ranjan Name: Mr. Rajneesh Kumar

Signature: 1.....

Name: Mr. Saurabh Samaddar

External Members

Signature: 1.....

Name: Prof. Satish C. Sharma

Date: 04/09/2025

Encl.: Recommended Curriculum attached for consideration and approval.

CC:

1. Dean
2. Registrar Office

Program Educational Objectives

At Rama University Mechanical Engineering program will prepare its graduates to:

PEO 1: Plan, design, constructs, maintain and improve mechanical engineering systems that are technically sound, economically feasible and socially acceptable.

PEO 2: Apply analytical, computational and experimental techniques to address the challenges faced in mechanical and allied engineering streams.

PEO 3: Communicate effectively using conventional platforms as well as innovative / online tools and demonstrate collaboration, networking & entrepreneurial skills.

PEO 4: Exhibit professionalism, ethical attitude, team spirit and pursue lifelong learning to achieve career, organizational and societal goals.

Program Specific Outcomes

PSO-1 Apply mechanical and interdisciplinary knowledge to analyze, design and manufacture products to address the needs of the society.

PSO-2 Apply state of the art tools and techniques to conceptualize, design and introduce new products, processes, systems and services.

Program Outcomes:

PO1 - Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

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, social, and environmental considerations.

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.

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.

PO6 - The engineer and the world: Apply reasoning to assess societal, health, safety, legal, cultural, and environmental issues, demonstrating responsibility for sustainable development in engineering practice.

PO7 - Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO8 - Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO9 - 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 - 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 - 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.

Chairperson

Signature: .....

Name: Dr. Indrajeet Gupta

Date:

Internal Members

Signature: 1.....

Name: Dr. Narendra Kumar

2.....

Name: Dr. Deeksha Ranjan

3.....

Name: Mr. Rajneesh Kumar

Signature: 1.....

Name: Mr. Saurabh Samaddar

External Members

Signature: 1.....

Name: Prof. Satish C. Sharma

04/09/2025

HOD ME <hodme.fet@ramauniversity.ac.in>

Invitation regarding to BOS review meeting

1 message

HOD ME <hodme.fet@ramauniversity.ac.in> 30 August 2025 at 16:17
To: sshmefme@me.iitr.ac.in
Cc: Dean Academics Rama University <deanacademics@ramauniversity.ac.in>, HOD Applied Sciences & Humanities <hodas.fet@ramauniversity.ac.in>, Rajeesh Kumar <rajeesh.fet@ramauniversity.ac.in>

Dear Professor,

On behalf of the Department of Mechanical Engineering, Rama University, we are pleased to invite you to attend the **Board of Studies (BOS) Review Meeting** scheduled as per the following details:

Date: 01/09/2025 (Monday)
Time: 12:00 PM to 01:00 PM
Venue: FET, Rama University, Kanpur

Time zone: Asia/Kolkata
Google Meet joining info
Video call link: https://meet.google.com/rxs-xjuo-ppd
Or dial: (US) +1 860-415-6873 PIN: 838 167 991#

The objective of the meeting is to review and discuss the syllabus, curriculum structure, and academic improvements to align with the latest industry and academic requirements.

Your valuable insights and contributions will play a vital role in strengthening the curriculum and enhancing the academic quality of our programs.

We sincerely look forward to your presence and guidance in the BOS Review.

Please find the enclose documents

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Best & Regards,
Dr. Narendra Kumar
Assistant Professor & Head
Department of Mechanical Engineering
Faculty of Engineering and Technology
Rama University, Kanpur (U.P.)
Mob. No.- 8269974712

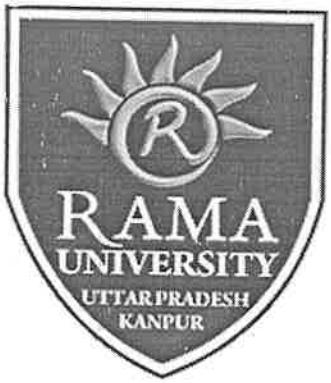
3 attachments

RR25 B.Tech MECHANICAL Scheme.xlsx
25K

B.Tech(R-25)_MOM_2025-26.docx
94K

RR25 BTech ME Syllabus 2025-26.docx
294K

ORDINANCE
For
Bachelor of Technology (B. Tech)
(Mechanical Engineering)



Faculty of Engineering, Rama University

Preamble

This Ordinance governs the Bachelor of Technology (B. Tech) programme offered in the Faculty of Engineering, Rama University, with specializations in Mechanical Engineering. The provisions herein define the framework, policies, academic regulations, and structural guidelines that regulate the operation of the Programme. The aim is to provide a comprehensive understanding of the curriculum structure, admission norms, evaluation procedures, and student responsibilities. This ordinance is designed in line with AICTE, UGC, and National Education Policy (NEP-2020) guidelines.

1. Program Name & Code

The Bachelor of Technology (B. Tech) is an Undergraduate (UG) Programme in Engineering. It is offered in Rama University under the Faculty of Engineering, with the specializations **Mechanical Engineering**.

Each specialization shall be assigned a unique Programme Code as per the University's nomenclature system. The B. Tech program has been designed to prepare graduates with strong fundamentals, practical exposure, and research aptitude.

2. Eligibility Criteria

The minimum qualification required for admission is 10+2 (Intermediate) or equivalent examination with Physics and Mathematics as compulsory subjects, along with Chemistry/Computer Science/Information Technology/Biology as one of the optional subjects. Candidates must secure at least 45% marks in aggregate (45% for SC/ST Candidates). Relaxation in minimum percentage is provided for candidates belonging to reserved categories as per government/University rules. If any student has an RT status in any subject while being declared pass in the overall result, the student must clear the RT status before the commencement of the academic session in order to be eligible for admission.

For Lateral Entry: Candidates holding a Diploma in Engineering/Technology (in relevant branch) or B.Sc. with Mathematics as a subject may be admitted directly into the 2nd year (3rd semester) of the programme, provided they fulfill the eligibility requirements. Candidates must secure at least 45% marks in aggregate (40% for SC/ST Candidates).

3. Admission Procedure

Admissions shall be carried out through the following mechanisms:
-Rama University Entrance Test (RUET)
-Based on National/State-level Entrance Tests (e.g., JEE Mains, State CETs)
-Direct admission through counseling on the basis of merit in qualifying examination, subject to availability of seats.
Lateral Entry candidates shall be admitted in accordance with University rules and AICTE guidelines. Admission shall also be subject to verification of original documents, eligibility criteria, and compliance with reservation policies.

4. Duration of the Programme

The normal duration of the programme is 4 academic years, divided into 8 semesters. Each academic year consists of two semesters (Odd and Even), each of approximately 16 to 18 weeks, inclusive of teaching, internal assessment, and semester-end examinations.

5. Maximum Duration for Completion

The maximum permissible duration to complete the programme is 7 academic years (14 semesters) from the date of admission. This includes all breaks, backlogs, academic suspensions, or re-admissions. Students unable to complete within this period shall not be entitled to a degree.

6. Medium of Instruction

The medium of instruction, course delivery, examinations, assignments, and laboratory work shall be strictly in English. Students are encouraged to improve communication skills in English through remedial and language enhancement courses offered by the University.

7. Structure of the Programme

The programme follows a Choice Based Credit System (CBCS). The curriculum comprises:
- Core Courses (fundamental and advanced engineering subjects)
- Professional Elective
- Open Electives (interdisciplinary courses from other faculties)
- Practical and Laboratory Courses
- Project Work (Minor & Major)
- Internships and Industrial Training
- Seminars, Workshops, and Viva Voce.

Semester Wise Course Structure & Evaluation Scheme:

I SEM											
S No	Course Category	Course Code	Course Name	L	T	P	C	CA	MTE	ETE	TOTAL MARKS
1	BSC	BCN1001	Mathematics-I	3	1	0	4	30	20	50	100
2	ESC	BCN1002	Electrical and Electronics Engineering	3	0	0	3	30	20	50	100
3	BSC	BCN1003/BCN2007	Physics	3	0	0	3	30	20	50	100
4	ESC	BCN1004	Problem Solving using Programming	3	0	0	3	30	20	50	100
5	ESC	BCN1005/BCN2008	Mechanical Engineering and Robotics	3	0	0	3	30	20	50	100
6	ESC	BCN1052	Electrical and Electronics Engineering Lab	0	0	2	1	30	20	50	100
7	BSC	BCN1053/2057	Physics Lab	0	0	2	1	30	20	50	100
8	ESC	BCN1054	Problem Solving using Programming Lab	0	0	2	1	30	20	50	100
9	ESC	BCN1055/BCN2058	Workshop/Manufacturing Practices Lab	0	0	2	1	30	20	50	100
			Total	15	1	8	20				900

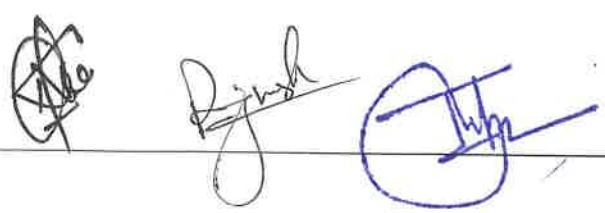
II SEM											
S No	Course Category	Course Code	Course Name	L	T	P	C	CA	MTE	ETE	TOTAL MARKS
1	BSC	BCN2001	Mathematics-II	3	1	0	4	30	20	50	100
2	BSC	BCN2002/1007	Chemistry	3	0	0	3	30	20	50	100
3	PCC	BCN2003	Engineering Mechanics	3	0	0	3	30	20	50	100
4	HSC	BCN2004/1008	Life Skills: Entrepreneurship, Language, Communication and Personality	3	0	0	3	30	20	50	100
6	MC	BCN2005	Universal Human Values-II: Understanding Harmony And Ethical Human Conduct	2	1	0	3	30	20	50	100
11	AUC	BCN2006	Hobbies, Co-Curricular and Extra-Curricular	2	0	0	0	30	20	50	100
7	BSC	BCN2052/1057	Chemistry Lab	0	0	2	1	30	20	50	100
8	PCC	BCN2053	Engineering Graphics Lab	0	0	2	1	30	20	50	100
9	HSC	BCN2054/1058	Life Skills: Entrepreneurship, Language, Communication and Personality Lab	0	0	2	1	30	20	50	100
10	ESC	BCN2059	Design thinking and innovation Lab	0	0	2	1	30	20	50	100
			Total	**16**	**2**	**8**	**20**				**1000**

III SEM											
S No	Course Category	Course Code	Course Name	L	T	P	C	CA	MTE	ETE	TOTAL MARKS
1	PCC	BME3001	Mathematics-III	3	1	0	4	30	20	50	100
2	PCC	BME3002	Engineering Thermodynamics	3	0	0	3	30	20	50	100
3	PCC	BME3003	Fluid Mechanics and Machinery	3	0	0	3	30	20	50	100
4	PCC	BME3004	Mechanics of Deformable Bodies	3	0	0	3	30	20	50	100
5	PCC	BME3005	Primary Manufacturing	2	0	0	2	30	20	50	100
6	PCC	BME3006	Theory of Machines	3	0	0	3	30	20	50	100
7	PCC	BME3052	Engineering Thermodynamics Lab	0	0	2	1	30	20	50	100
8	PCC	BME3053	Fluid Mechanics and Machinery Lab	0	0	2	1	30	20	50	100
9	PCC	BME3054	Mechanics of Deformable Bodies Lab	0	0	2	1	30	20	50	100
10	PCC	BME3055	Primary Manufacturing Lab	0	0	2	1	30	20	50	100
11	PCC	BME3056	Theory of Machines Lab	0	0	2	1	30	20	50	100
12	MC	BCN3007	Humanities-I	2	0	0	2	30	20	50	100
			Total	19	1	10	25	360	240	600	1200



IV SEM											
S No	Course Category	Course Code	Course Name	L	T	P	C	CA	MTE	ETE	TOTAL MARKS
1	PCC	BME4001	Applied Thermal Engineering	3	1	0	4	30	20	50	100
2	PCC	BME4002	Design of Machine Elements	3	1	0	4	30	20	50	100
3	PCC	BME4003	Measurement & Metrology	3	0	0	3	30	20	50	100
4	PCC	BME4004	Machine Tools and Machining	3	0	0	3	30	20	50	100
5	PCC	BME4005	Electrical Machines and Control Theory	3	0	0	3	30	20	50	100
6	PCC	BME4051	Thermal Engineering Lab	0	0	2	1	30	20	50	100
7	PCC	BME4053	Measurement & Metrology Lab	0	0	2	1	30	20	50	100
8	PCC	BME4056	Machine Tools and Machining Lab	0	0	2	1	30	20	50	100
9	PCC	BME4055	Electrical Machines and Control Theory Lab	0	0	2	1	30	20	50	100
10	PCC	BME4057	Computer Aided Drafting and Modelling Laboratory	0	0	2	2	30	20	50	100
11	MC	BCN4007	Environmental Sciences	3	0	0	0	30	20	50	100
			Total	18	3	10	23	330	220	550	1100

V SEM											
S No	Course Category	Course Code	Course Name	L	T	P	C	CA	MTE	ETE	TOTAL MARKS
1	PCC	BME5001	Heat Transfer	3	1	0	4	30	20	50	100
2	PEC	BMEP301-BMEP320	Professional Elective -I	3	0	0	3	30	20	50	100
3	PCC	BME5003	Non-Traditional and Computer Aided Manufacturing	3	0	0	3	30	20	50	100
4	OEC	BMEO401-BMEO417	Open Elective-I	3	1	0	4	30	20	50	100
5	PCC	BME5005	Computer Aided Design	3	1	0	4	30	20	50	100
6	PCC	BME5051	Heat Transfer Lab	0	0	2	1	30	20	50	100
7	PEC	BMEP351-BMEP354	Professional Elective -I Lab	0	0	2	1	30	20	50	100
8	PCC	BME5053	Non-traditional and Computer Aided Manufacturing Lab	0	0	2	1	30	20	50	100
9	PCC	BME5055	Computer Aided Design Lab	0	0	2	1	30	20	50	100
10	PCC	BME5056	Undergraduate Research in Mechanical Engineering	0	0	2	1	30	20	50	100
11	MC	BCN5007	Essence of Indian Knowledge Tradition	0	0	0	0	30	20	50	100
			Total	15	3	10	23	330	220	550	1100



VI SEM											
S No	Course Category	Course Code	Course Name	L	T	P	C	CA	MTE	ETE	TOTAL MARKS
1	PEC	BMEP301-BMEP320	Professional Elective- II	3	0	0	3	30	20	50	100
2	OEC	BMEO401-BMEO417	Open Elective-II	3	0	0	3	30	20	50	100
3	OEC	BMEO401-BMEO417	Open Elective-II	3	0	0	3	30	20	50	100
4	PCC	BME6001	Industrial Engineering	3	1	0	4	30	20	50	100
5	PCC	BME6002	Operation Research	3	0	0	3	30	20	50	100
6	PCC	BME6005	Product Design Development	2	0	0	2	30	20	50	100
7	PCC	BME6054	Mini Project	0	0	2	1	30	20	50	100
8	PCC	BME6055	Numerical and Statistical Methods Lab	0	0	2	1	30	20	50	100
			Total	17	1	4	20	240	160	400	800
			Total Up to 6th Semester				#				
11	PCC	BME6006	Summer Internship/ Field Work (Minimum 8 weeks) *				1	50		50	100
* This credit will be reflected in VII semester result.											

VII SEM										
S No	Course Category	Course Code	Course Name	L	T	P	C	CA	MTE	ETE	TOTAL MARKS
1	PEC	BMEP301-BMEP320	Professional Elective -III	3	0	0	3	30	20	50	100
2	OEC	BMEO401-BMEO417	Open Elective-III	3	0	0	3	30	20	50	100
3	PCC	BME7001	Dynamic System Vibration and Control	3	0	0	3	30	20	50	100
4	PRC	BME7052	Capstone Project Phase-I	0	0	12	6	50	50	100	200
			Total	9	0	12	15	140	110	250	500
or											
1	OEC	BMEO401-BMEO417	Open Elective-III	3	0	0	3	30	20	50	100
2	PRC	BME7052	Industrial Project/R&D Project/Industry Internship/Start-up/Externship	0	0	24	12	110	90	200	400
			Total	3	0	24	15	140	110	250	500

VIII SEM										
S No	Course Category	Course Code	Course Name	L	T	P	C	CA	MTE	ETE	TOTAL MARKS
1	PEC	BMEP301-BMEP320	Professional Elective - IV	3	0	0	3	30	20	50	100
2	OEC	BMEO401-BMEO417	Open Elective-IV	3	0	0	3	30	20	50	100

3.	PRC	BME8051	Capstone Project Phase-II	0	0	18	9	50	50	100	200
			Total	6	0	18	15	110	90	200	400

Professional Elective

S. No.	Course Category	Course Code	Course Name	L	T	P	C	CA	MTE	ETE	Total
1	PEC	BMEP301	Introduction to Automobile engineering	3	0	0	3	30	20	50	100
2	PEC	BMEP302	Refrigeration and Air-Conditioning	3	0	0	3	30	20	50	100
3	PEC	BMEP303	Computer Aided Manufacturing	3	0	0	3	30	20	50	100
4	PEC	BMEP304	Heat treatment and processing	3	0	0	3	30	20	50	100
5	PEC	BMEP351	Introduction to Automobile engineering Lab	0	0	2	1	30	20	50	100
6	PEC	BMEP352	Refrigeration and Air-Conditioning Lab	0	0	2	1	30	20	50	100
7	PEC	BMEP353	Computer Aided Manufacturing Lab	0	0	2	1	30	20	50	100
8	PEC	BMEP354	Heat treatment and processing Lab	0	0	2	1	30	20	50	100
9	PEC	BMEP305	Automotive vehicle design	3	0	0	3	30	20	50	100
10	PEC	BMEP306	Fundamentals of HVAC	3	0	0	3	30	20	50	100
11	PEC	BMEP307	Mechatronics	3	0	0	3	30	20	50	100
12	PEC	BMEP308	Materials testing and characterization	3	0	0	3	30	20	50	100
13	PEC	BMEP309	Automotive Electrical and Electronics System	3	0	0	3	30	20	50	100
14	PEC	BMEP310	Off road vehicles	3	0	0	3	30	20	50	100
15	PEC	BMEP311	Electrical design and aspects of HVAC	3	0	0	3	30	20	50	100
16	PEC	BMEP312	Introduction to Robotics	3	0	0	3	30	20	50	100
17	PEC	BMEP313	Power Plant Engineering	3	0	0	3	30	20	50	100
18	PEC	BMEP314	Principles of materials selection	3	0	0	3	30	20	50	100
19	PEC	BMEP315	Power Electronics for Electric Vehicle Application	3	0	0	3	30	20	50	100
20	PEC	BMEP316	Vehicle body engineering	3	0	0	3	30	20	50	100
21	PEC	BMEP317	HVAC design	3	0	0	3	30	20	50	100
22	PEC	BMEP318	Robotic programming and simulation	3	0	0	3	30	20	50	100
23	PEC	BMEP319	Surface engineering	3	0	0	3	30	20	50	100
24	PEC	BMEP320	Vehicle Dynamics	3	0	0	3	30	20	50	100

Open Elective

S. No.	Course Category	Course Code	Course Name	L	T	P	C	CA	MTE	ETE	Total
1	OEC	BMEO401	Measurement and Quality	3	0	0	3	30	20	50	100
2	OEC	BMEO402	Organization Behaviour	3	0	0	3	30	20	50	100

3	OEC	BMEO403	Engineering Materials	3	0	0	3	30	20	50	100
4	OEC	BMEO404	Bio-Materials	3	0	0	3	30	20	50	100
5	OEC	BMEO405	Assurance Value Engineering	3	0	0	3	30	20	50	100
6	OEC	BMEO406	Industrial Tribology	3	0	0	3	30	20	50	100
7	OEC	BMEO407	Total Quality Management	3	0	0	3	30	20	50	100
8	OEC	BMEO408	Non Destructive Testing	3	0	0	3	30	20	50	100
9	OEC	BMEO409	Biomedical-Instrumentation	3	0	0	3	30	20	50	100
10	OEC	BMEO410	Design Methodology	3	0	0	3	30	20	50	100
11	OEC	BMEO411	Finite Element Analysis	3	0	0	3	30	20	50	100
12	OEC	BMEO412	I.C Engines	3	0	0	3	30	20	50	100
13	OEC	BMEO413	Rehabilitation Engineering	3	0	0	3	30	20	50	100
14	OEC	BMEO414	Reliability and Quality Control	3	0	0	3	30	20	50	100
15	OEC	BMEO415	Six Sigma: Quality and Methodology	3	0	0	3	30	20	50	100
16	OEC	BMEO416	Computer Graphics	3	0	0	3	30	20	50	100
17	OEC	BMEO417	Therapeutic Equipment	3	0	0	3	30	20	50	100

8. Marks/Credit Distribution

The total credit of 162 is distributed among various course categories throughout the 8 semesters. The breakdown is as follows:

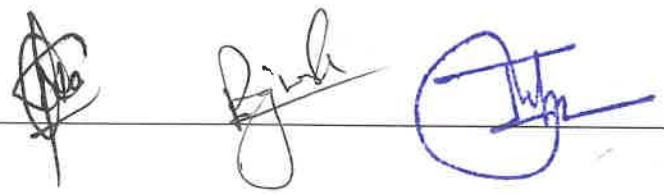
1. Core & Compulsory Courses:
   Theory/Lab
   PCC Theory (Professional Core Courses): 61 credits
   PCC Lab (Professional Core Courses): 18 credits

   BSC Theory (Basic Science Courses): 14 credits
   BSC Lab (Basic Science Courses): 2 credits

   ESC Theory (Engineering Science Courses): 9 credits
   ESC Lab (Engineering Science Courses): 4 credits

   HSC Theory (Humanities & Social Sciences): 3 credits
   HSC Lab (Humanities & Social Sciences): 1 credits

   MC (Mandatory Courses): 5 credits
2. Professional Electives
   Theory: 12 credits
   Lab: 1 Credit
3. Project/Internship: 16 credits



4. Open Electives: 16 credits

One credit is defined as:
- 1 lecture hour per week = 1 credit
- 1 tutorial hour per week = 1 credit
- 2 practical/lab hours per week = 1 credit

9. Evaluation Procedure

The evaluation scheme is divided into Continuous Internal Evaluation (CIE) and End Term Examination (ETE).
Continuous Internal Evaluation (CIE) divided into
Continuous Assessment (CA) and Mid Term Examination (MTE)
Assessment Components, are structured as:
CA: 30 Marks,
MTE: 20 Marks,
and ETE: 50 Marks, Total 100 Marks.

Continuous Assessment (CA), the distribution will be:
Attendance – **10 Marks,** and
Assignments/Quiz/Seminar/Term Paper/Certificate/Class Project – **20 Marks.**

Mid Term Examination (MTE) **-20 Marks** includes written theory papers, viva voce, and practical examinations conducted by internal examiners
and End Term Examination (ETE) – **50 Marks**
includes written theory papers, viva voce, and practical examinations conducted by internal and external examiners.

Weightage: CIE (50%), ETE (50%). A student must secure a minimum of 40% in each component and 50% aggregate to pass.

10. Rules for Backlogs / Supplementary Exams

Students failing in a subject may appear in supplementary examinations conducted as per the academic calendar. They are allowed a maximum of attempts to clear each backlog course as per University norms. Improvement examinations are permitted only for theory papers in which the student has already passed but wishes to improve marks, subject to approval of the Examination Cell.

11. Special Academic Requirements

In addition to regular coursework, every student must complete:
- Industrial visits (minimum 2 during the programme)
- Summer internship (4-6 weeks after 4th semester)
- Major Internship/Industrial Training (6 months in final year)
- Minor Project (6th semester)
- Major Project/Dissertation (7th-8th semester)

- Seminar and Viva Voce presentations

Participation in workshops, hackathons, coding competitions, and research publications is strongly encouraged.

12. Other Provisions

Attendance: Students must maintain a minimum of 75% attendance in every course to be eligible for appearing in examinations. Condonation may be granted in exceptional cases, as per University rules.

Discipline: Students must adhere to the code of conduct, anti-ragging policies, academic integrity rules, and ethical guidelines laid down by the University.

Use of Technology: Students are encouraged to complete online certification courses (MOOCs/NPTEL/SWAYAM) to earn credits.

Plagiarism and Malpractice: Strict action will be taken against students found guilty of unfair practices in examinations, assignments, or project work.

13. Exit Options (NEP-2020)

In accordance with NEP-2020 guidelines, the programme provides multiple exit options:

- After 1 year (2 semesters): **Certificate in Mechanical Engineering**
- After 2 years (4 semesters): **Diploma in Mechanical Engineering**
- After 3 years (6 semesters): **Advanced Diploma in Mechanical Engineering**
- After 4 years (8 semesters): **B. Tech Degree in Mechanical Engineering**

Students opting for exit must fulfill credit requirements and apply formally to the University.

Conclusion

This Ordinance shall come into effect from the academic session 2025-26 and shall be applicable to all new admissions henceforth. The University reserves the right to amend, modify, or update the Ordinance as and when required, subject to approval by statutory bodies. Any interpretation of these regulations shall rest with the Academic Council of Rama University.

Faculty of Engineering and Technology
Rama University, Kanpur
Department of Mechanical Engineering
Evaluation Scheme

I SEM

S No	Course Category	Course Code	Course Name	L	T	P	C	CA	MTE	ETE	Total
1	BSC	BCN1001	Mathematics-I	3	1	0	4	30	20	50	100
2	ESC	BCN1002	Electrical and Electronics Engineering	3	0	0	3	30	20	50	100
3	BSC	BCN1003/BCN2007	Physics	3	0	0	3	30	20	50	100
4	ESC	BCN1004	Problem Solving using Programming	3	0	0	3	30	20	50	100
5	ESC	BCN1005/BCN2008	Mechanical Engineering and Robotics	3	0	0	3	30	20	50	100
6	ESC	BCN1052	Electrical and Electronics Engineering Lab	0	0	2	1	30	20	50	100
7	BSC	BCN1053/2057	Physics Lab	0	0	2	1	30	20	50	100
8	ESC	BCN1054	Problem Solving using Programming Lab	0	0	2	1	30	20	50	100
9	ESC	BCN1055/BCN2058	Workshop/Manufacturing Practices Lab	0	0	2	1	30	20	50	100
			Total	**15**	**1**	**8**	**20**	**270**	**180**	**450**	**900**
			Total Up to 1st Semester				**20**				

II SEM

S No		Course Code	Course Name	L	T	P	C	CA	MTE	ETE	Total
1	BSC	BCN2001	Mathematics-II	3	1	0	4	30	20	50	100
2	BSC	BCN2002/1007	Chemistry	3	0	0	3	30	20	50	100
3	PCC	BCN2003	Engineering Mechanics	3	0	0	3	30	20	50	100
4	HSC	BCN2004/1008	Life Skills: Entrepreneurship, Language, Communication and Personality	3	0	0	3	30	20	50	100
5	MC	BCN2005	Universal Human Values-II: Understanding Harmony And Ethical Human Conduct	2	1	0	3	30	20	50	100
6	AUC	BCN2006	Hobbies, Co-Curricular and Extra-Curricular	2	0	0	0	30	20	50	100
7	BSC	BCN2052/1057	Chemistry Lab	0	0	2	1	30	20	50	100
8	PCC	BCN2053	Engineering Graphics Lab	0	0	2	1	30	20	50	100
9	HSC	BCN2054/1058	Life Skills: Entrepreneurship, Language, Communication and Personality Lab	0	0	2	1	30	20	50	100
10	ESC	BCN2059	Design thinking and innovation Lab	0	0	2	1	30	20	50	100
			Total	**16**	**2**	**8**	**20**	**300**	**200**	**500**	**1000**
			Total Up to 2nd Semester				**40**				

III SEM

S No		Course Code	Course Name	L	T	P	C	CA	MTE	ETE	Total

1	PCC	BME3001	Mathematics-III	3	1	0	4	30	20	50	100
2	PCC	BME3002	Engineering Thermodynamics	3	0	0	3	30	20	50	100
3	PCC	BME3003	Fluid Mechanics and Machinery	3	0	0	3	30	20	50	100
4	PCC	BME3004	Mechanics of Deformable Bodies	3	0	0	3	30	20	50	100
5	PCC	BME3005	Primary Manufacturing	3	0	0	3	30	20	50	100
6	PCC	BME3006	Theory of Machines	2	0	0	2	30	20	50	100
7	PCC	BME3052	Engineering Thermodynamics Lab	0	0	2	1	30	20	50	100
8	PCC	BME3053	Fluid Mechanics and Machinery Lab	0	0	2	1	30	20	50	100
9	PCC	BME3054	Mechanics of Deformable Bodies Lab	0	0	2	1	30	20	50	100
10	PCC	BME3055	Primary Manufacturing Lab	0	0	2	1	30	20	50	100
11	PCC	BME3056	Theory of Machines Lab	0	0	2	1	30	20	50	100
12	MC	BCN3007	Humanities-I	2	0	0	2	30	20	50	100
			Total	**19**	**1**	**10**	**25**	**360**	**240**	**600**	**1200**
			Total Up to 3rd Semester	**65**							

IV SEM

S No		Course Code	Course Name	L	T	P	C	CA	MTE	ETE	Total
1	PCC	BME4001	Applied Thermal Engineering	3	1	0	4	30	20	50	100
2	PCC	BME4002	Design of Machine Elements	3	1	0	4	30	20	50	100
3	PCC	BME4003	Measurement & Metrology	3	0	0	3	30	20	50	100
4	PCC	BME4004	Machine Tools and Machining	3	0	0	3	30	20	50	100
5	PCC	BME4005	Electrical Machines and Control Theory	3	0	0	3	30	20	50	100
6	PCC	BME4051	Thermal Engineering Lab	0	0	2	1	30	20	50	100
7	PCC	BME4053	Measurement & Metrology Lab	0	0	2	1	30	20	50	100
8	PCC	BME4056	Machine Tools and Machining Lab	0	0	2	1	30	20	50	100
9	PCC	BME4055	Electrical Machines and Control Theory Lab	0	0	2	1	30	20	50	100
10	PCC	BME4057	Computer Aided Drafting and Modelling Laboratory	0	0	2	2	30	20	50	100
11	MC	BCN4007	Environmental Sciences	3	0	0	0	30	20	50	100
			Total	**18**	**3**	**10**	**23**	**330**	**220**	**550**	**1100**
			Total Up to 4th Semester	**88**							

V SEM

S No		Course Code	Course Name	L	T	P	C	CA	MTE	ETE	Total
1	PCC	BME5001	Heat Transfer	3	1	0	4	30	20	50	100
2	PEC	BMEP301-BMEP320	Profesional Elective -I	3	0	0	3	30	20	50	100
3	PCC	BME5003	Non-Traditional and Computer Aided Manufacturing	3	0	0	3	30	20	50	100
4	OEC	BMEO401-BMEO417	Open Elective-I	3	1	0	4	30	20	50	100
5	PCC	BME5005	Camputer Aided Design	3	1	0	4	30	20	50	100
6	PCC	BME5051	Heat Transfer Lab	0	0	2	1	30	20	50	100
7	PEC	BMEP351-BMEP354	Professional Elective -I Lab	0	0	2	1	30	20	50	100
8	PCC	BME5053	Non-traditional and Computer Aided Manufacturing Lab	0	0	2	1	30	20	50	100
9	PCC	BME5055	Camputer Aided Design Lab	0	0	2	1	30	20	50	100
10	PCC	BME5056	Undergraduate Research in Mechanical Engineering	0	0	2	1	30	20	50	100
11	MC	BCN5007	Essence of Indian Knowledge Tradition	0	0	0	0	30	20	50	100
			Total	**15**	**3**	**10**	**23**	**330**	**220**	**550**	**1100**



			Total Up to 5th Semester	111							
VI SEM											
S No		**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**CA**	**MTE**	**ETE**	**Total**
1	PEC	BMEP301-BMEP320	Profesional Elective- II	3	0	0	3	30	20	50	100
2	OEC	BMEO401-BMEO417	Open Elective-II	3	0	0	3	30	20	50	100
3	OEC	BMEO401-BMEO417	Open Elective-II	3	0	0	3	30	20	50	100
4	PCC	BME6001	Industrial Engineering	3	1	0	4	30	20	50	100
5	PCC	BME6002	Operation Research	3	0	0	3	30	20	50	100
6	PCC	BME6005	Product Design Development	2	0	0	2	30	20	50	100
7	PCC	BME6054	Mini Project	0	0	2	1	30	20	50	100
8	PCC	BME6055	Numerical and Statistical Methods Lab	0	0	2	1	30	20	50	100
				17	1	4	20	240	160	400	800
			Total Up to 6th Semester	131							
9	PCC	BME6006	Summer Internship/ Field Work (Minimum 8 weeks)*	1							
* This credit will be reflected in VII semester result.											
			Total	132							

VII SEM											
S No		**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**CA**	**MTE**	**ETE**	**Total**
1	PEC	BMEP301-BMEP320	Profesional Elective -III	3	0	0	3	30	20	50	100
2	OEC	BMEO401-BMEO417	Open Elective-III	3	0	0	3	30	20	50	100
3	PCC	BME7001	Dynamic System Vibration and Control	3	0	0	3	30	20	50	100
4	PRC	BME7052	Capstone Project Phase-I	0	0	12	6	50	50	100	200
			Total	9	0	12	15	140	110	250	500
or											
1	OEC	BMEO401-BMEO417	Open Elective-III	3	0	0	3	30	20	50	100
2	PRC	BME7052	Industrial Project/R&D Project/Industry Internship/Start-up/Externship	0	0	24	12	110	90	200	400
			Total	3	0	24	15	140	110	250	500
			Total Up to 7th Semester	147							

VIII SEM											
S No		**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**CA**	**MTE**	**ETE**	**Total**
1	PEC	BMEP301-BMEP320	Profesional Elective -IV	3	0	0	3	30	20	50	100
2	OEC	BMEO401-BMEO417	Open Elective-IV	3	0	0	3	30	20	50	100
3	PRC	BME8051	Capstone Project Phase-II	0	0	18	9	50	50	100	200
			Total	6	0	18	15	110	90	200	400
			Total Up to 8th Semester	162							

Professional Electives											
S. No.		**Course Code**	**Course Name**	**L**	**T**	**P**	**Credit**	**CA**	**MTE**	**ETE**	**Total**

1	PEC	BMEP301	Introduction to Automobile engineering	3	0	0	3	30	20	50	100
2	PEC	BMEP302	Refrigeration and Air-Conditioning	3	0	0	3	30	20	50	100
3	PEC	BMEP303	Computer Aided Manufacturing	3	0	0	3	30	20	50	100
4	PEC	BMEP304	Heat treatment and processing	3	0	0	3	30	20	50	100
5	PEC	BMEP351	Introduction to Automobile engineering Lab	0	0	2	1	30	20	50	100
6	PEC	BMEP352	Refrigeration and Air-Conditioning Lab	0	0	2	1	30	20	50	100
7	PEC	BMEP353	Computer Aided Manufacturing Lab	0	0	2	1	30	20	50	100
8	PEC	BMEP354	Heat treatment and processing LAb	0	0	2	1	30	20	50	100
9	PEC	BMEP305	Automotive vehicle design	3	0	0	3	30	20	50	100
10	PEC	BMEP306	Fundamentals of HVAC	3	0	0	3	30	20	50	100
11	PEC	BMEP307	Mechatronics	3	0	0	3	30	20	50	100
12	PEC	BMEP308	Materials testing and characterization	3	0	0	3	30	20	50	100
13	PEC	BMEP309	Automotive Electrical and Electronics System	3	0	0	3	30	20	50	100
14	PEC	BMEP310	Off road vehicles	3	0	0	3	30	20	50	100
15	PEC	BMEP311	Electrical design and aspects of HVAC	3	0	0	3	30	20	50	100
16	PEC	BMEP312	Introduction to Robotics	3	0	0	3	30	20	50	100
17	PEC	BMEP313	Power Plant Engineering	3	0	0	3	30	20	50	100
18	PEC	BMEP314	Principles of materials selection	3	0	0	3	30	20	50	100
19	PEC	BMEP315	Power Electronics for Electric Vehicle Application	3	0	0	3	30	20	50	100
20	PEC	BMEP316	Vehicle body engineering	3	0	0	3	30	20	50	100
21	PEC	BMEP317	HVAC design	3	0	0	3	30	20	50	100
22	PEC	BMEP318	Robotic programming and simulation	3	0	0	3	30	20	50	100
23	PEC	BMEP319	Surface engineering	3	0	0	3	30	20	50	100
24	PEC	BMEP320	Vehicle Dynamics	3	0	0	3	30	20	50	100

Open Elective

S. No.		Course Code	Course Name	L	T	P	Credit	CA	MTE	ETE	Total
1	OEC	BMEO401	Measurement and Quality	3	0	0	3	30	20	50	100
2	OEC	BMEO402	Organization Behaviour	3	0	0	3	30	20	50	100
3	OEC	BMEO403	Engineering Materials	3	0	0	3	30	20	50	100
4	OEC	BMEO404	Bio-Materials	3	0	0	3	30	20	50	100
5	OEC	BMEO405	Assurance Value Engineering	3	0	0	3	30	20	50	100
6	OEC	BMEO406	Industrial Trobology	3	0	0	3	30	20	50	100
7	OEC	BMEO407	Total Quality Management	3	0	0	3	30	20	50	100
8	OEC	BMEO408	Non Destrictive Testing	3	0	0	3	30	20	50	100
9	OEC	BMEO409	Biomedical-Instrumentation	3	0	0	3	30	20	50	100
10	OEC	BMEO410	Design Methodology	3	0	0	3	30	20	50	100
11	OEC	BMEO411	Finite Element Analysis	3	0	0	3	30	20	50	100
12	OEC	BMEO412	I.C Engines	3	0	0	3	30	20	50	100
13	OEC	BMEO413	Rehabilitation Engineering	3	0	0	3	30	20	50	100
14	OEC	BMEO414	Reliability and Quality Control	3	0	0	3	30	20	50	100
15	OEC	BMEO415	Six Sigma: Quality and Methodology	3	0	0	3	30	20	50	100
16	OEC	BMEO416	Computer Graphics	3	0	0	3	30	20	50	100

17	OEC	BMEO417	Therapeutic Equipment	3	0	0	3	30	20	50	100

Terminology and Abbreviation

L-T-P: Lecture-Tutorial-Practical hours per week.	
Credits: Calculated as per AICTE norms (1 credit per lecture/tutorial hour, 0.5 credits per practical hour).	
HSC: Humanities and Social Sciences including Management Courses	
BSC: Basic Science Courses	
ESC: Engineering Science Courses	
Profe	
PEC: Professional Elective Courses	
OEC: Open Elective Courses	
PRC: Project Work, Seminar, Internship Courses	
MC: Mandatory Courses	
AUC: Audit Cources	
BMEP: Computer Science Specialization Elective	
BMEP: Computer Science Professional Elective	
BMEO: Computer Science Open Elective	

MOOC: As per page no 191 of AICTE Model Curriculum for UG Degree Course 2022

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Program Structure & Syllabus

Bachelor of Technology (Mechanical Engineering)

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Semester-I

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BCN1001	Mathematics-I	L	T	P	C
Owning School/Department	FET	3	1	0	4
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Solving system of linear equations by using Gaussian elimination to reduce the augmented matrix to row echelon form or to reduced row echelon form.
CO2: To be familiar with the concepts of dimension of a subspace and the rank and nullity of a matrix.
CO3: To calculate the Eigen values and eigenvectors of a square matrix using the characteristic polynomial.

Course Contents:

UNIT I: **06 lecture hours**
Curvature, evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

UNIT II: **06 lecture hours**
Rolle's Theorem, Mean value theorems and applications; Extreme values of functions; Linear approximation; Indeterminate forms and L' Hospital's rule.

UNIT III: **10 lectures hours**
Limits of sequence of numbers, Calculation of limits, Infinite series; Tests for convergence; Power series, Taylor and Maclaurin series; Taylor theorem, convergence of Taylor series, error estimates.

UNIT IV: **08 lectures hours**
Limit, continuity and partial derivatives, directional derivatives, gradient, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers.

UNIT V: **10 lectures hours**
Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals,
Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), orthogonal curvilinear

coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Gradient, curl and divergence, Theorems of Green, Gauss and Stokes.

Text Books:

1. Strang, Gilbert. *Introduction to linear algebra.* 4th ed. Wellesley-Cambridge Press, 2006.ISBN 978-0030105678.
2. Kreyszig, Erwin. *Advanced Engineering Mathematics 10th Edition with Wiley Plus Set.* John Wiley & Sons, 2010. ISBN978-0470458365.

Reference Books:

1. Hoffmann, Kenneth, and Ray Alden Kunze. *Linear algebra.* 2nd ed. Prentice-Hall, 2004.ISBN 9789332550070.
2. Simmons, George F. *Differential equations with applications and historical notes.* 2nd ed.McGraw-Hill Education (India) Pvt Limited, 2002. ISBN978-0070530713.
3. Coddington, Earl A. *An introduction to ordinary differential equations.* 1st ed. DoverPublication, 1989. ISBN 9780486659428.

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BCN1002/ BCN1052	Electrical and Electronics Engineering	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	2	4
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: To articulate the fundamental parameters governing an electrical circuit such as current, voltage.

CO2: To explain basic electronic components such as resistors, capacitors, and inductors.

CO3: To make use of concepts, working, and application of various circuits using the components on a breadboard.

Course Contents:

UNIT I: **12 lecture hours**

Electronics: Semiconductor Fundamentals, Diodes: Characteristics and Applications in Digital Circuits, Transistors - BJTs and MOSFETs as Switches, Logic Gates using Diodes and Transistors, Digital Systems and Binary Representation, Number Systems and conversion, Boolean Algebra and Logic Gates, Combinational Logic Design: Truth Tables and Boolean Expressions, Combinational Logic Design: Karnaugh Maps and Simplification, Multiplexers, Decoders, and Encoders, Adders and Subtractors, Sequential Logic Design: Flip-Flops - SR, JK, Sequential Logic Design: D and T Flip-Flops, Registers, Counters

UNIT II: **10 lecture hours**

Sensors and Transducers, Common Types of Sensors - Temperature, Light, Common Types of Sensors - Motion, Pressure, Actuators - Motors, Relays, Interfacing Sensors and Actuators, Power Electronics: Voltage Regulation, Power Electronics: DC-DC Converters, Analog-to-Digital Conversion -ADC, Digital-to-Analog Conversion -DAC, Microcontrollers - Architecture

UNIT III: **08 lecture hours**

Circuit Elements and Ohm's Law, Kirchhoff's Current Law -KCL, Kirchhoff's Voltage Law - KVL, Series and Parallel Resistor Combinations

UNIT IV: **06 lecture hours**

Single-Phase AC Circuits, Circuit Elements in AC, Impedance and Admittance, Phasor Representation and Power

UNIT V: **06 lecture hours**

Principles of Operation, Relevance in Computing Systems, Electrical Machines Applications

List of Experiment:

1. Diode Characteristics and Applications in Simple Circuits
2. Transistor as a Switch: Experimental Verification
3. Implementation of Logic Gates using Transistors

4. Verification of Boolean Algebra and Truth Tables using Logic Gates
5. Design and Implementation of Combinational Logic Circuits
6. Implementation and Testing of Sequential Logic Circuits: Flip-Flops and Counters
7. Verification of Kirchhoff's Laws in DC Circuits
8. Analysis of Series and Parallel Resistor Circuits
9. Measurement of Voltage, Current, and Impedance in AC Circuits
10. Sensor Characteristics and Interfacing
11. Interfacing and Controlling Simple Actuators
12. Microcontroller Programming and I/O Operations

Text Books:

1. Charles, K. Alexander, and N. O. Matthew. *Fundamentals of electric circuits.* 1st ed. McGraw-hill Education, 2017.ISBN 9789353165505.
2. Boylestad, Robert L., and Louis Nashelsky. *Electronic devices and circuit theory.* 1st ed. Pearson Education India, 2009. ISBN 9788131703144.
3. Tsividis, Yannis. *A First Lab in Circuits and Electronics.* 1st ed. Wiley, 2002. ISBN 9780471386957.

Reference Books:

1. Neamen, Donald A. *Microelectronics: circuit analysis and design.* 1st ed. New York: McGraw-Hill, 2009.ISBN 978-0073380643.
2. Bell, David A. *Electronic instrumentation and measurements.* 3rd ed. Oxford University Press India, 2013. ISBN 978-0195696141.

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BCN1003/2007/ BCN1053/2057	Physics	L	T	P	C
Owning School/Department	FET	3	0	2	4
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Apply relativistic principles to solve basic physical problems.
CO2: Apply quantum physics principles to solve basic physical problems.
CO3: Analyze and use Maxwell's equations in modeling EM systems.
CO4: Describe and utilize wave optics for imaging and diagnostics.
CO5: Understand lasers and fiber optics for sensing and data transmission.

Course Contents:

UNIT I: **06 lecture hours**

Inertial and non-inertial frames, Galilean vs Lorentz transformations, Postulates of Special Relativity, Time dilation, length contraction, Relativistic momentum and energy, Mass-energy equivalence: equivalence: $E=mc2$

UNIT II: **06 lecture hours**

Limitations of classical physics, de-Broglie hypothesis; Davisson-Germer experiment, Phase and group velocity, Schrödinger equation (time-dependent and time-independent), Wave function interpretation; particle in a dimensional box

UNIT III: **06 lecture hours**

Continuity equation, displacement current, Maxwell's equations (differential & integral forms), Electromagnetic waves in vacuum and conductors; Poynting vector, Skin depth

UNIT IV: **04 lecture hours**

Coherent sources, interference (thin films, Newton's rings), Diffraction: single slit, double slit, diffraction grating, absent spectra, dispersive and resolving power

UNIT V: **06 lecture hours**

Total internal reflection, Step-index vs. graded-index fibers, Numerical aperture, attenuation, dispersion, Applications in sensors, Spontaneous and stimulated emission, He-Ne and Ruby lasers, Laser applications

List of Experiments:

Group A

1. To determine the wavelength of sodium light by Newton's ring experiment.
2. To determine the wavelength of different spectral lines of mercury light using plane transmission grating.
3. To determine the specific rotation of cane sugar solution using polar-meter.
4. To determine the focal length of the combination of two lenses separated by a distance and

verify the formula for the Focal length of combination of lenses.
5. To measure attenuation in an optical fiber.
6. To determine the wavelength of He-Ne laser light using single slit diffraction.
7. To study the polarization of light using He-Ne laser light.
8. To determine the wavelength of sodium light with the help of Fresnel's bi-prism.
9. To determine the coefficient of viscosity of a given liquid.
10. To determine the value of acceleration due to gravity (g) using compound pendulum.

Group B

1. To determine the energy band gap of a given semiconductor material.
2. To study Hall effect and determine Hall coefficient, carrier density and mobility of a given semiconductor Material using Hall Effect setup.
3. To determine the variation of magnetic field with the distance along the axis of a current carrying coil and Estimate the radius of the coil.
4. To verify Stefan's law by electric method.
5. To determine resistance per UNIT length and specific resistance of a given resistance using Carey Fosters Bridge.
6. To study the resonance condition of a series LCR circuit.
7. To determine the electrochemical equivalent (ECE) of copper.
8. To calibrate the given ammeter and voltmeter by potentiometer.
9. To draw hysteresis (B-H curve) of a specimen in the form of a transformer and to determine its Hysteresis loss.
10. To measure high resistance by leakage method.

Text Books:

1. Practical Physics- K. K. Dey & B. N. Dutta (Kalyani Publishers New Delhi)
2. Engineering Physics-Theory and Practical- Katiyar & Pandey (Wiley India)
3. Engineering Physics Practical- S K Gupta (Krishna Prakashan Meerut)

Text Books:

1. Concepts of Modern Physics – Arthur Beiser
2. Introduction to Electrodynamics – David J. Griffiths
3. Optics – Ajoy Ghatak Engineering Physics – D.C. Tayal



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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BCN1004/BCN1054	Problem Solving using Python	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	2	4
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:
CO1: Solve given problem in Python by using standard programming constructs.
CO2: Build programs using the features of object-oriented programming languages.
CO3: Make use of Python inbuilt APIs to write functions.

Course Contents:

UNIT I: **12 lecture hours**

Programming Concepts, Features and Applications of Python, Setting up Python Development Environment, Keywords, Identifiers, Statements, Indentation, Comments, Variables Declaration, Assignment, Naming Conventions, Data Types: Integers, Floating-Point Numbers, Strings, Booleans. Input and Output using print- and input- functions, Numbers and Arithmetic Operators - Addition, Subtraction, Multiplication, Division, Modulus, Exponentiation, Floor Division, Operator Precedence, Comparison Operators - Equal to, Not Equal to, Greater than, Less than, Greater than or Equal to, Less than or Equal to. Logical Operators: and, or, not, Type Conversion - Implicit and Explicit Type Conversion, Bitwise Operators, Assignment Operators

UNIT II: **08 lecture hours**

Conditional Statements - if, else, elif statements, Nested Conditional Statements, Loops: while loop. Loop Control Statements: break, continue, pass, For loop: Iterating over sequences - strings, lists, tuples for loop with range- function, Nested Loops, for-else and while-else constructs

UNIT III: **06 lecture hours**

Strings - Creating Strings, Accessing Characters, String Slicing, String Immutability, String Operations - Concatenation, Repetition, String Formatting - % operator and format- method, f-strings, Common String Methods: upper-, lower-, strip-, split-, join-, find-, replace-

UNIT IV: **08 lecture hours**

Functions - Calling Functions, Return Values, Function Parameters - Positional Arguments, Keyword Arguments, Default Arguments, Scope of Variables - Local and Global Scope, Function Composition, Recursion: Factorial, Fibonacci Sequence. Lambda Functions, UNITs, Importing UNITs - import, import as, Standard UNITs - math, random.

UNIT V: **08 lecture hours**

Lists-Creating Lists, Accessing Elements, List Slicing. List Operations: Concatenation, Repetition, append-, insert-, remove-, pop-, index-, count-, sort-, reverse-. List Comprehension, Tuples: Creating Tuples, Accessing Elements, Tuple Slicing, Tuple Immutability, Tuple Operations: Concatenation, Repetition. Tuple Methods -count-, index-, Creating Dictionaries, Accessing Elements - Keys, Values, Items, Dictionary Mutability, Common Dictionary

Methods: keys-, values-, items-, get-, update-, pop-, popitem-, clear-. Dictionary Comprehension, Creating Sets, Union, Intersection, Difference, Symmetric Difference, Set Methods -add, remove, discard, update, intersection update-

List of Experiments:

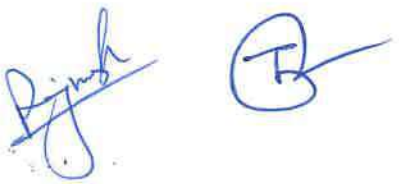
1. Setting up Python environment, writing and running simple Python programs.
2. Lab exercises on if, else, and elif statements.
3. Implementing while loops and using break, continue, pass statements.
4. String manipulation exercises: indexing, slicing, concatenation, and repetition.
5. Implementing programs using various string methods.
6. Lab exercises on function parameters and scope of variables.
7. Implementing recursive functions and using lambda functions.
8. Working with Lists: creating, accessing, slicing, and operations.
9. Practicing List methods and List Comprehension.
10. Working with Tuples: creating, accessing, slicing, and operations.
11. Working with Dictionaries: creating, accessing, and modifying dictionaries.
12. Practicing Dictionary methods and Dictionary Comprehension. Sets and Set operations.

Text Books:

1. Sundarrajan M, Mani Deepak Choudhry, "Python Programming Beginners Guide", 2024.
2. Deepali Srivastava, "Ultimate Python Programming", BPB Online 2024.
3. Dierbach, Charles. Introduction to computer science using python: A computational problem-solving focus. Wiley Publishing, 2012. ISBN 9789332584686.

Reference Books:

1. Martinez, D. and Jesús, S. D, Applied Computational Thinking with Python: Design Algorithmic Solutions for Complex and Challenging Real-world Problems. Packt Publishing, 2021. ISBN 89351507314.



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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BCN1005/BCN2008	Mechanical Engineering & Robotics	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Understanding of the correlation between the internal structures of materials.

CO2: Explain of basics of Measurements & measurement systems.

CO3: After studying this UNIT student will know understand of fluid and its properties, manometer, hydrostatic forces acting on different surfaces and also problem solving techniques.

CO4: Calculate Apply various laws of thermodynamics to various processes and real systems.

CO5: Understand the historical background, robotic configuration, how to map the trajectory of links, use to forward and inverse kinematics.

Course Contents:

UNIT I: **06 lecture hours**

Materials

Classification of engineering material, Composition of cast iron and carbon steels on iron-carbon diagram and their mechanical properties, alloy steel and their applications; Stress-strain diagram, Hooks law and modulus of elasticity. Tensile, shear, hardness and fatigue testing of materials

UNIT II:

Measurement **08 lecture hours**

Introduction: Introduction to measurement and measuring instruments, generalized measuring system and functional elements, UNITs of measurement, static and dynamic performance characteristics of measurement devices, calibration, concept of error, sources of error, statistical analysis of errors, Measurement by Vernier caliper, micrometer, dial gauges, slip gauges, sine-bar and combination set, Introduction to lath, drilling, milling and shaping machines.

UNIT III:

Fluid **12 lecture hours**

Fluid properties, pressure, density and viscosity; pressure variation with depth, Static and kinetic energy; Bernoulli's equation for incompressible fluids, Flow Types-Viscous and turbulent flow etc, working principle of pumps, turbines, positive displacement machines, Hydraulic power & pumped storage plants for peak load management as compared to base load plants or hydrodynamic force of jets on stationary and moving flat and inclined vanes

UNIT4: **08 lecture hours**

Thermodynamics

Microscopic and Macroscopic approaches, Properties and state, Thermodynamic properties, Thermodynamic path, process and cycle, Thermodynamic equilibrium, Zeroth law of thermodynamics First and second law of thermodynamics, Classification and working of boilers, efficiency & performance analysis, Refrigeration, vapor absorption & compression

cycles, coefficient of perform (COP), refrigerant properties, Working of two stroke, four stroke petrol & diesel engines.

UNIT5: **08 lecture hours**

Robotics Introduction and Modeling

Introduction: Definition, Structure, Classification and Specifications of Robots, Industrial Robots, Robot Elements and Control: Manipulators, Drives, Sensors, End Effectors, Configuration, Trajectory Planning, Position Control, Modeling of Robots: Coordinate Frames, Mapping and Transformation; Direct Kinematic & inverse Kinematics.

Text Books:

1. Narula; Material Science; TMH
2. Agrawal B & CM; Basic Mechanical Engg. Wiley India
3. Nag PK, Tripathi et al; Basic Mechanical Engg; TMH
4. Rajput; Basic Mechanical Engg;
5. Sawhney GS; Fundamentals of Mechanical Engg; PHI

Reference Books:

1. Nakra and Chaudhary; Instrumentation & measurement; TMH
2. Nag PK; Engineering Thermodynamics; TMH
3. Ganesan; Combustion Engines; TMH

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BCN1055	Workshop/ Manufacturing Practices Lab	L	T	P	C
Owning School/Department	Mechanical Engineering	0	0	2	1
Pre-requisites/Exposure	-				

UNIT I: Introduction

Manufacturing Processes and its Classification, Casting, Machining, Plastic deformation and metal forming, Joining Processes, Heat treatment process, Assembly process, Powder Metallurgy

UNIT II: Sheet Metal and Machine Shop

Sheet Metal: Study of tools and operations, fabrication of tool box, tray etc., Machine Shop: Demonstration of working, construction and accessories for lathe machine, perform operations on lathe-facing, plane turning, step turning, tapper turning, threading, knurling and parting.

UNIT III: Black Smithy and Carpentry Shop

Use of various smithy tools, forging operations: Upsetting, Punching and drafting. Suggested Jobs: Forging of chisel, Wood Working tools: Wood working machinery, joints & joinery. Making of Cross Half Lap Joint and T joint

UNIT IV: Fitting Shop:

Practice making operation, preparation of U & V shape Male Femal Work Piece ehich contains Filing, Sawing, Drilling, and Grinding.

UNIT V: Welding

Study and use of tools used for Gas & Arc welding. Preparing Lap & Butt joints using gas and arc welding methods, Safety precautions, Introduction to BI standards and reading of welding drawings

Text Books:

1. Colvin, F. H. and Haas, L. L., Jigs and Fixtures – A Reference Book, McGraw Hill (1938).
2. Joshi, P. H., Jigs and Fixtures, McGraw Hill (1988).
3. Basu, Mukherjee, Mishra, Fundamentals of Tool Engg. Design, Oxford & IBH Publishing (1996).

Reference Books:

1. Pandey and Shan, Modern Machining Processes, McGraw Hill.
2. Bawa Workshop Practice, TMH
3. Manufacturing Technology- P.N. Rao, Vol.1&2, TMH
4. Workshop Practices - HazaraChoudhary, Vol. I & II.
5. Production Technology - R.K. Jain.

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Semester-II

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BCN2001	Mathematics-II	L	T	P	C
Owning School/Department	FET	3	1	0	4
Pre-requisites/Exposure	-				

Course Outcomes (COs)

CO1: To apply differential and integral calculus to notions of curvature and to improper integrals.
Apart from some other applications they will have a basic understanding of Beta and Gamma functions.
CO2: The fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering
problems.
CO3: The tool of power series and Fourier series for learning advanced Engineering Mathematics.
CO4: To deal with functions of several variables that are essential in most branches of engineering.
CO5: To acquaint the student with mathematical tools needed in evaluating multiple integrals and
their usage.

Course Contents:

UNIT I: **08 lecture hours**

Why Probability and Statistics for Engineers, Role of uncertainty, data-driven engineering, populations/samples, variable types, Exploring Distributions, Histograms, density plots, box plots , Descriptive Statistics: Measures of Center and Spread, Mean, median, mode, variance, std dev, percentiles, Probability Fundamentals: Sample Spaces, Events, Axioms - Sets, operations, axioms of probability, calculations, Conditional Probability and Independence, Bayes' Theorem and Law of Total Probability, Calculating posterior probabilities, partitioning sample space

UNIT II: **08 lecture hours**

Discrete Random Variables: PMFs and Expectation, Definition, probability mass function, expected value, Variance of Discrete RVs; Bernoulli and Binomial Distributions, Variance calculation, properties and applications of Bernoulli/Binomial, Poisson and Geometric Distributions, Properties, applications -e.g., arrivals, waiting times, relation to Binomial, Continuous Random Variables: PDFs and CDFs, Definition, probability density function, cumulative distribution function, Expectation and Variance of Continuous RVs; Uniform Distribution.

UNIT III: **10 lecture hours**

Statistical Inference; Random Sampling, Population vs Sample, parameters vs statistics, simple random sampling, Sampling Distribution of Sample Mean, Concept, mean and variance of $\bar{X}$, Central Limit Theorem -CLT, Statement, conditions, importance, applications, Sampling

Distribution of Sample Proportion, Mean, variance, normal approximation, Point Estimation: Method of Moments and MLE, finding estimators for simple cases -mean, variance, proportion.

UNIT IV: **08 lecture hours**

Framework of Hypothesis Testing, Null/Alternative hypotheses, Type I/II errors, α, p-value, Hypothesis Testing for Population Mean -σ known/unknown, Z-test and t-test procedures, interpreting results, connection to Cis, Hypothesis Testing for Population Proportion, Z-test procedure, conditions for validity, Comparing Two Means -Independent Samples t-test, Procedure, assumptions, interpretation, Chi-Square Tests: Goodness-of-Fit, Chi-square distribution, testing fit to a hypothesized distribution, Bayesian Inference, Frequentist vs Bayesian philosophy, Bayes' theorem for parameters, prior/posterior

UNIT V: **08 lecture hours**

Simple Linear Regression -SLR Model, Scatter plots, Correlation coefficient, SLR model equation -β0, β1, ϵ, SLR: Least Squares Estimation, estimating intercept and slope, fitting regression line, SLR: Interpretation and Model Assessment, Interpreting coefficients, R2, residual analysis, Multiple Linear Regression, Concept of multiple predictors, future directions.

Text Books:

1. "Probability and Statistics for Engineers and Scientists" by Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, and Keying Ye

2. "Introduction to Probability and Statistics for Engineers and Scientists" by Sheldon M. Ross.

Reference Books:

1. "Applied Statistics and Probability for Engineers" by Douglas C. Montgomery and George C. Runger.

2. "Statistics for Engineers and Scientists" by William Navidi

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BCN2002/1007, BCN2052/1057	Chemistry	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	2	4

Course Outcomes (COs)

CO1: To enable the students to understand the Chemistry of Atomic and Molecular structure, band structure of solids, chemistry of advanced Materials like Liquid crystals, Nanomaterials and Graphite & fullerenes.
CO2: To enable the students to understand and apply the detailed concepts of spectroscopic techniques and stereochemistry to identify the compounds, element etc.
CO3: To enable students to understand the concept of organic reactions.
CO4: To enable the students to understand and apply concepts related to Electrochemistry, Corrosion and Chemical kinetics.
CO5: To enable the students to understand and apply detailed concepts of water impurities, hardness of water, as well as analysis of coal & determination of calorific values.

Course Contents:

UNIT I:

Atomic and Molecular Structure: Molecular orbitals of diatomic molecules, Bond Order, Magnetic characters and numerical problems.
Band structure of solids: and the role of doping on band structures.
Chemistry of Advanced Materials:
Liquid Crystals; Introduction, Types and Applications of liquid crystals, industrially important materials used as liquid crystals.
Graphite and Fullerene; Introduction, Structure and applications.
Nanomaterials; Introduction, Preparation, characteristics of nanomaterials and applications of nanomaterials, Carbon Nano Tubes (CNT),

UNIT II:

Spectroscopic Techniques and Applications:
Principles of spectroscopy and selection rules, Elementary idea and simple applications of UV, IR and NMR, Numerical problems
Stereochemistry:
Enantiomers, diastereomers, optical activity, absolute configurations, conformational analysis

UNIT III:

Organic reactions:
Introduction to reactions involving substitution, addition, elimination, cyclization and ring openings
Mechanism of Name reactions: (i) Aldol condensation (ii) Cannizzaro reaction (iii) Beckmann rearrangement. (iv)Hofmann rearrangement and (v) Diels-Alder reaction

UNIT IV:

Electrochemistry: Basic concepts of electrochemistry. Nernst equation and applications
Corrosion: Introduction to corrosion, Types of corrosion, Cause of corrosion, Corrosion prevention and control, Corrosion issues in specific industries (Power generation, Chemical processing industry, Oil & gas industry and Pulp & paper industries).

Chemical Kinetics: Rate, order and molecularity of reaction, Integrated rate equation of zero order, first order and second order reactions.

UNIT V:

Water Technology:
Sources and impurities of water, Municipality waste water treatment, Hardness of water, Disadvantages of hard water, Techniques for water softening (Lime-Soda, Zeolite, Ion Exchange and Reverse Osmosis process), Numerical problems.

Fuels and Combustion:
Definition, Classification, Characteristics of a good fuel, Calorific Values, Gross & Net calorific value, Determination of calorific value by Bomb Calorimeter, Theoretical calculation of calorific value by Dulong's method, Ranking of Coal, Analysis of coal by Proximate and Ultimate analysis method, Numerical problems.

List of Experiments:

1. Determination of alkalinity in the given water sample.
2. Determination of Temporary and Permanent hardness in water sample using EDTA as standard solution.
3. Determination of available chlorine in bleaching powder.
4. Determination of chloride content in the given water sample by Mohr's method.
5. Determination of Iron content in the given Iron ore sample by using $[K_3Fe(CN)_6]$ as an external indicator.
6. Determination of solubility of salt (NaCl) at room temperature.
7. Determine the viscosity of a given solution.
8. Element detection and Functional group identification in organic compounds.
9. Preparation of Bakelite & Urea Formaldehyde resin.
10. Verification of Beer's law.
11. Determination of surface tension of given liquid.
12. Determination of rate constant of hydrolysis of esters.

Text/Reference Books:

1. AICTE's Prescribed Textbook: Chemistry – I with Lab Manual, Khanna Book Publishing.
2. Engineering Chemistry, by Manisha Agrawal.
3. University chemistry, by B. H. Mahan.
4. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane.

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BCN2003	Engineering Mechanics	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:
CO1: Discuss and Understand and analyze forces, moments and their applications in real life situations.
CO2: Describe and understand the basic concepts of the laws of friction and moment of inertia and its real life applications.
CO3: Analyze and determine the forces in members of trusses and frames.
CO4: Apply fundamental concepts of kinematics and kinetics of particles and rigid bodies to the analysis of practical problems.

Course Contents:

UNIT I: **10 lecture hours**

Static of Force System

Composition and resolution of forces, concurrent, non-concurrent and parallel forces in a plane, Free body diagrams, Moment of a force and Varigon's theorem, conditions of equilibrium, Polygon of, forces, equivalent force system, Bodies in equilibrium, structures under equilibrium, Couple, moment of a couple, equivalent couple, and addition of couples

UNIT II: **11 lecture hours**

Centroid & Moment of Inertia, Friction

Location of centroid and Moment of Inertia of plane areas, Perpendicular Axis and Parallel Axis theorems, Product of Inertia, Principal Axes and Principal Moment of solid bodies. Coloumb's law of friction, Friction on inclined plane, Limiting friction, Angle of friction, Laws of Friction, Static and Dynamic friction, Ladder and wedge friction, Illustrative exercises.

UNIT III: **11 lectures hours**

Transmission of Power

Transmission of power through Belt, Rope and Gears, Ratio and tension on tight side and slack sides, Centrifugal tension, Lifting machines; Spur, Bevel, Worm gearing, Rack and Pinion gear, Gear Trains, Simple and compound pulleys, Illustrative exercises.

UNIT IV: **10 lectures hours**

Shear Force and Bending Moment:

Shear Force and Bending Moment Diagram for Cantilever and simply supported beam with concentrated, distributed load, and couple, Overhanging beams, Point of Inflexion/Contra-flexure, Relationship between bending moment and shear for pure bending.
Illustrative exercises.

UNIT V: **10 lectures hours**

Virtual Work and Trusses:

Concept and principle of virtual work, Degree of freedom of system, use and application of virtual work for problems on beams, ladders, frames, virtual work done by moment/ torque, Perfect and imperfect truss, Analysis of trusses, method of joints, method of sections, graphical method for perfect trusses, Illustrative exercises.

Text Books:

1. Vector Mechanics for Engineers, Statics and Dynamics by Beer and Johnston, McGraw Hill Education
2. Engineering Mechanics, S. Timoshenko, D.H. Young, 5th Edition, 2017 (Reprint).
3. Engineering Mechanics: Statics and Dynamics, Irving H. Shames, 4th Edition, 2011.
4. Vector Mechanics for Engineers: Statics and Dynamics, Ferdinand Beer, E. Russell Johnston Jr., Elliot R. Eisenberg, 12th Edition, 2017.
5. Engineering Mechanics, Basudeb Bhattacharya, 2nd Edition, 2016.

Reference Books:

1. Engineering Mechanics: Statics By Andrew Pytel | JaanKiusalaas, Cengage Learning
2. Engineering Mechanics byBasuddeb Bhattacharyya, Oxford University Press
3. Engineering Mechanics - Statics and Dynamics by R. C. Hibbeler, A. Gupta, Pearson
4. Engineering Mechanics - Statics and Dynamics By S K Sinha, Pearson
5. Engineering Mechanics, S. Sen Gupta, Latest Edition, 2017.

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Name of Program	Bachelor of Technology (Mechanical Engineering)				
BCN2004/1008 BCN2054/1058	Life Skills: Entrepreneurship, Language, Communication and Personality	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Identify and correct common grammatical and writing errors for effective communication.

CO2: Apply reading and writing strategies to comprehend, summarize, and produce professional documents.

CO3: Demonstrate effective communication, leadership, and conflict management skills in practical scenarios.

Course Contents:

UNIT I: **06 lecture hours**

Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies, Clichés

UNIT II: **06 lecture hours**

Employing different reading skills, Comprehension passage – Understanding the author's point of View, the art of condensation- Summarization, paraphrasing, précis and abstract writing, Reading short stories (Rabindranath Tagore, MunsiPremchand, Mulk Raj Anand and James Joyce), Writing business letters and reports

UNIT III: **08 lecture hours**

Process and principles of effective business communication, Types of Communication-(Verbal Communication, Non-verbal Communication, Interpersonal Communication, Extra personal Communication, Intrapersonal Communication, Mass Communication and Media Communication etc., Barriers to communication, Remedies to overcome from the barriers of Communication

UNIT IV: **08 lecture hours**

Oral and Written Presentations: Technical Communication, Essential Elements of Effective Presentations and Speaking as a Leader, Gaining Power and Influence: Building a Strong Power Base, Motivating Others and Diagnosing Work Performance Problems, Managing Conflict: Interpersonal and Collaborative Approaches, Case Studies and Practice Sessions

Laboratory:

1. Group Discussion, Conversations and dialogue- Practical based on relevant Grammatical Patterns.

2. Practice of Communication Skills for Seminars/Conferences/Workshops with emphasis on Paralinguistic /Kinesics.
3. Presentation Skills for Technical Paper/Project Reports/ Professional Reports based on proper Stress and Intonation Mechanics
4. Public Speaking practice by conducting elocution, extempore, debate and speech competition
5. Theme Presentation/ Keynote Presentation based on correct methodologies
6. Individual Speech Delivery/Conferencing with skills to defend Interjections/Quizzes
7. Argumentative Skills/Role Play Presentation with Stress and Intonation.
8. Comprehension Skills based on Reading and Listening Practical's on a model Audio

Text Books:

1. Wood, F.T. *Remedial English Grammar*. Macmillan, 2007.
2. Kumar, Sanjay and Pushp Lata. *Communication Skills*. Oxford University Press, 2011.
3. Seely, John. *Oxford Guide to Effective Writing and Speaking*. Oxford University Press, 2013.
4. Sudharshana, N.P., and C. Savitha. *English for Engineers*. Cambridge University Press, 2018.
5. Joyce, James. *Dubliners (Modern Classics)*. Penguin Books, 2000.

Reference Books:

1. Tagore, Rabindranath. *The Home-Coming*. CI Publisher, 2014.
2. Anand, Mulk Raj. *The Lost Child and Other Stories*. Orient Publishing, 2004.
3. McCarthy, Michael, and Felicity O'Dell. *English Vocabulary in Use (Intermediate)*. Cambridge University Press, 2002.
4. Quirk, Randolph. *A Comprehensive Grammar of the English Language*. Pearson Education India, 2010.

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Name of Program	Bachelor of Technology (Mechanical Engineering)				
BCN2055	Workshop/Manufacturing Practices	L	T	P	C
Owning School/Department	FET	0	0	2	1
Pre-requisites/Exposure	-				

UNIT-1: Introduction

Manufacturing Processes and its Classification, Casting, Machining, Plastic deformation and metal forming, Joining Processes, Heat treatment process, Assembly process, Powder Metallurgy

UNIT-2: Sheet Metal and Machine Shop

Sheet Metal: Study of tools and operations, fabrication of tool box, tray etc., Machine Shop: Demonstration of working, construction and accessories for lathe machine, perform operations on lathe-facing, plane turning, step turning, tapper turning, threading, knurling and parting.

UNIT-3: Black Smithy and Carpentry Shop

Use of various smithy tools, forging operations, Punching and drafting. Suggested Jobs: Forging of chisel, forging of Screw Driver, Wood Working tools: Making of Cross Half lap joint and T joint.

UNIT-4: Fitting Shop:

Study and use of Measuring instruments, Engineer steel rule, Surface gauges' caliper, Height gauges, feeler gauges, micro meter, Different types of files, File cuts, File grades, Use of surface plate, Surface gauges drilling tapping Fitting operations: Chipping filling, Drilling and tapping. Praparation of U or V Shape Male Femal Work Piece which contains Filing, Sawing, Drilling and Grinding

UNIT-5: Welding

Study and use of tools used for Gas & Arc welding. Preparing Lap &Butt joints using gas and arc welding methods, Safety precautions, Introduction to BI standards and reading of welding drawings

Text Books-

1. Colvin, F. H. and Haas, L. L., Jigs and Fixtures – A Reference Book, McGraw Hill (1938).
2. Joshi, P. H., Jigs and Fixtures, McGraw Hill (1988).
3. Basu, Mukherjee, Mishra, Fundamentals of Tool Engg. Design, Oxford & IBH Publishing (1996).

Reference Books-

4. Pandey and Shan, Modern Machining Processes, McGraw Hill.
5. Bawa Workshop Practice, TMH
6. Manufacturing Technology- P.N. Rao, Vol.1&2, TMH
7. Workshop Practices - HazaraChoudhary, Vol. I & II.
8. Production Technology - R.K. Jain

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Name of Program	Bachelor of Technology (Mechanical Engineering)				
BCN2006	Hobbies, Co-Curricular and Extra-Curricular	L	T	P	C
Owning School/Department	FET	2	0	0	0
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:
CO1: To make the students understand the importance of sound health and fitness principles as they
relate to better health.
CO2: To expose the students to a variety of physical and yogic activities aimed at stimulating their
continued inquiry about Yoga, physical education, health and fitness.
CO3: To create a safe, progressive, methodical and efficient activity based plan to enhance improvement and minimize risk of injury.
CO4: To develop among students an appreciation of physical activity as a lifetime pursuit and a means to better health.

Course Contents:

UNIT I:

Meaning & definition of Physical Education, Aims & Objectives of Physical Education, Changing trends in Physical Education

UNIT II:

Ancient & Modern Olympics (Summer & Winter), Olympic Symbols, Ideals, Objectives & Values, Awards and Honours in the field of Sports in India (Dronacharya Award, Arjuna Award, Dhayanchand Award, Rajiv Gandhi Khel Ratna Award etc.)

UNIT III:

Meaning & Importance of Physical Fitness & Wellness, Components of Physical fitness, Components of Health related fitness, Components of wellness, Preventing Health Threats through Lifestyle Change, Concept of Positive Lifestyle

UNIT IV:

Define Anatomy, Physiology & Its Importance, Effect of exercise on the functioning of Various Body Systems. (Circulatory System, Respiratory System, Neuro-Muscular System etc.)

UNIT V:

Meaning & Importance of Kinesiology & Biomechanics in Physical Edu. & Sports, Newton's Law of Motion & its application in sports, Friction and its effects in Sports.

UNIT VI:

Meaning and Concept of Postures, Causes of Bad Posture, Advantages & disadvantages of weight training, Concept & advantages of Correct Posture, Common Postural Deformities – Knock Knee; Flat Foot; Round Shoulders; Lordosis, Kyphosis, Bow Legs and Scoliosis, Corrective Measures for Postural Deformities

UNIT VII:

Meaning & Importance of Yoga, Elements of Yoga, Introduction - Asanas, Pranayama, Meditation & Yogic Kriyas, Yoga for concentration & related Asanas (Sukhasana; Tadasana; Padmasana &Shashankasana), Relaxation Techniques for improving concentration - Yog-nidra

UNIT VIII:

Asanas as preventive measures, Hypertension: Tadasana, Vajrasana, Pavan Muktasana, Ardha Chakrasana, Bhujangasana, Sharasana, Obesity: Procedure, Benefits & contraindications for Vajrasana, Hastasana, Trikonasana,Ardh Matsyendrasana., Back Pain: Tadasana, Ardh Matsyendrasana, Vakrasana, Shalabhasana, Bhujangasana, Diabetes: Procedure, Benefits & contraindications for Bhujangasana, Paschimottasana,Pavan Muktasana, Ardh Matsyendrasana, Asthema: Procedure, Benefits & contraindications for Sukhasana, Chakrasana, Gomukhasana, Parvatasana, Bhujangasana, Paschimottasana, Matsyasana.

UNIT IX:

Meaning of Training, warming up and limbering down, Skill, Technique & Style, Meaning and Objectives of Planning, Tournament – Knock-Out, League/Round Robin & Combination.

UNIT X:

Definition & Importance of Psychology in Physical Edu. & Sports, Define & Differentiate Between Growth & Development, Adolescent Problems & Their Management, Emotion: Concept, Type & Controlling of emotions, Meaning, Concept & Types of Aggressions in Sports, Psychological benefits of exercise, Anxiety & Fear and its effects on Sports Performance, Motivation, its type & techniques, Understanding Stress & Coping Strategies.

UNIT XI:

Meaning and Concept of Doping, Prohibited Substances & Methods, Side Effects of Prohibited Substances

UNIT XII:

First Aid – Definition, Aims & Objectives, Sports injuries: Classification, Causes & Prevention, Management of Injuries: Soft Tissue Injuries and Bone & Joint Injuries

UNIT XIII:

Athletics, Badminton, Basketball, Chess, Cricket, Kabaddi, Lawn Tennis, Swimming, TableTennis, Volleyball, Yoga etc, History of the Game/Sport, Latest General Rules of the Game/Sport, Specifications of Play Fields and Related Sports Equipment, Important Tournaments and Venues, Sports Personalities, Proper Sports Gear and its Importance.

Text Books/References:

1. Modern Trends and Physical Education by Prof. Ajmer Singh.
2. Light On Yoga by B.K.S. Iyengar.
3. Health and Physical Education – NCERT (11th and 12th Classes)

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Name of Program	Bachelor of Technology (Mechanical Engineering)				
BCN2053	Engineering Graphics Lab	L	T	P	C
Owning School/Department	FET	0	0	2	1
Pre-requisites/Exposure	-				

UNIT-I: Introduction to Drawing

Scales: Representative factor, plain scales, diagonal scales, types of scales, lettering sscales Conic sections: Construction of ellipse, parabola, and hyperbola by different methods. Normal and Tangent, Special Curves: Cycloid, Epee-cycloid, Hypo-cycloid, Involutes, Archimedean and logarithmic spirals.

UNIT-II: Projection

Types of projection, orthographic projection, first angle and third angle projection, Projection of points and lines, True inclinations and true length of straight lines, Traces of straight lines, Auxiliary planes

UNIT-III: Projection of planes and solids

Projection of circle, triangle and polygons, Projection of polyhedrons, Pyramids, Cylinders, Cones and Spheres in different positions

UNIT-IV: Section of Solids:

Section of right solids by normal and inclined planes, Intersection of cylinders, Development of Surfaces: Parallel line and radial - line method for right solids, Isometric Projections; Isometric scale, Isometric axes, Isometric Projection from orthographic drawing

UNIT-V: Introduction to Computer Aided Drafting (CAD).

Basic commands of drafting entities like line, circle, polygon, cylinders, Transformations and editing commands like move, rotate, mirror, array, scale etc, solids of revolution, Defining drawing size and printing/ plotting, Solution of projection problems on CAD.

Text Books-

1. Bhatt N.D., Paschal V.M. & Ingle P.R. (2014), Engineering Drawing, Charotar Publishing House.
2. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. Agrawal B. & Agrawal C.M. (2012), Engineering Graphics, McGraw Publication

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Semester-III

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Name of Program	Bachelor of Technology (Mechanical Engineering)				
BME3003/BME3053	Fluid Mechanics & Machinery/ Fluid Mechanics & Machinery Lab	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	2	4
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: After studying this UNIT student will know understand of fluid and its properties, manometer, hydrostatic forces acting on different surfaces and also problem solving techniques.
CO2: In this UNIT student will be to the basic laws of fluids, flow patterns, viscous flow through ducts and their corresponding problems.
CO3: At the end of this UNIT student will be Able to Calculcate related to boundary layer theory, flow separation, basic concepts of velocity profiles, dimensionless numbers and dimensional analysis.
CO4: In this UNIT student will analyze the hydrodynamic forces acting on vanes and their performance evaluation. The importance, function and performance of hydro machinery
CO5: After studying this UNIT student will be in a position to evaluate [V] the performance characteristics of hydraulic turbines. Also a little knowledge on hydraulic systems and fluidics is imparted to the student.

Course Contents:

UNIT I: Review of Fluid Properties and Fluid Statics

Engineering UNITs of measurement, mass, density, specific weight, volume and gravity, surface tension, capillarity, viscosity, bulk modulus of elasticity, pressure and vapor pressure, Pressure at a point, pressure variation in static fluid, Absolute and gauge pressure, Manometers, Forces on plane and curved surfaces (Problems on gravity dams and Tainter gates); Buoyant force, Stability of floating and submerged bodies, Relative equilibrium. Physical properties of fluids- specific gravity

UNIT II: Fluid Kinematics and Dynamics

Fluid Kinematics - Flow visualization - lines of flow - types of flow - velocity field and acceleration -continuity equation (one and three dimensional differential forms), Equation of streamline – stream function - velocity potential function – circulation, Fluid dynamics - equations of motion -Euler's equation along a streamline, Bernoulli's equation applications - Venturimeter, Orifice meter, Pitot tube, Dimensional analysis - Buckingham's π theorem-applications - similarity laws and models, Equation of continuity for one dimensional flow.

UNIT III: Introduction to Viscous Flows

Introduction to laminar &turbulent flow, Reynolds experiment &Reynolds number, Relation between shear & pressure gradient, Laminar flow through circular pipes, Laminar flow between parallel plates, Stokes law, lubrication principles, Transition from laminar to turbulent flow, Turbulent flow in circular pipe.

UNIT IV: Elements of Compressible Flows

Compressible flow properties total Enthalpy, total temperature, temperature and pressure ratio as function of Mach number, Mass flow parameter (MFP), velocity - area variation, 2-D small amplitude wave propagation, Description of flow regimes.

UNIT V: Hydraulic Turbines and Hydraulic Pumps

Hydro turbines: definition and classifications - Pelton turbine - Francis turbine - propeller turbine – Kaplan turbine, working principles of turbines, Pumps: definition and classifications, Working principles of pumps, Draft tube- theory functions and efficiency, Performance of hydraulic turbines: Geometric similarity, UNIT and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, Cavitation, surge tank, water hammer, Hydraulic systems hydraulic ram, hydraulic lift, advantages, limitations and applications.

Text Books:

1. Fluid Mechanics, Frank M. White, McGraw-Hill (9th Ed., 2021).
2. Fluid Mechanics, Victor L. Streeter, E. Benjamin Wylie, Keith W. Bedford, McGraw-Hill (9th Ed., 1998)
3. Fluid Mechanics and Machinery, Modi & Seth (Jagdish Lal Modi & S.M. Seth), Standard Book House (Revised Ed., 2017)
4. Mechanics of Fluids, Irving H. Shames, McGraw-Hill (4th Ed., 2003)
5. Fluid Mechanics and Hydraulic Machines, Rajput R.K, S. Chand (2020 Ed.)

Reference Books:

1. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria & Sons.
2. Fluid Mechanics, R.K. Bansal, Laxmi Publications (9th Ed., 2019).
3. Hydraulic Machines by Banga& Sharma, Khanna Publishers.
4. Instrumentation for Engineering Measurements by James W. Dally, William E. Riley, John Wiley & Sons Inc. 2004
5. Fluid Mechanics and Hydraulic Machines by Domkundwar & Domkundwar, Dhanpatrai & Co.

List of Experimental:

1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturi meter.
3. Calculation of the rate of flow using Rota meter.
4. Determination of friction factor for a given set of pipes.
5. Conducting experiments and drawing the characteristic curves of centrifugal pump/ submergible pump
6. Conducting experiments and drawing the characteristic curves of reciprocating pump.
7. Conducting experiments and drawing the characteristic curves of Gear pump.
8. Conducting experiments and drawing the characteristic curves of Pelton wheel.
9. Conducting experiments and drawing the characteristics curves of Francis turbine.
10. Conducting experiments and drawing the characteristic curves of Kaplan turbine.

TEXT BOOK:

1. Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi 2013.

REFERENCES:

1. Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011
2. Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd., New Delhi 2016

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Name of Program	Bachelor of Technology (Mechanical Engineering)				
BME3004/BME3054	Mechanics of Deformable Bodies/ Mechanics of Deformable Bodies Lab	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	2	4
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: understand the concept of "stress' and 'strain' will apply to structural member subjected to loading and also able to sketch Mohr's Circle.

CO2: compute the deflection of beam.

CO3: understand the concept of torsion of shafts.

CO4: solve deflection of spring and to compute buckling of column & Struts.

CO5: determine the various stresses induced in Thin & Thick Cylinders

Course Contents:

UNIT 1:

Mechanical properties of materials, Behavior of materials under tension, compression, bending, and shear, Stress and strain: stresses in members of a structure, axial loading, normal stress, shear stress, bearing stress, Analysis of simple structures, stepped rods, members in series and parallel, Stress strain diagram, Hooke's law, modulus of elasticity, stress due to temperature, Poisson's ratio, Bulk modulus, shear strain, relation among elastic constants, residual stress, strain energy under axial loads, Stresses due to impact of falling weights, Resilience, Proof resilience

UNIT II:

Transformation of stress and strain, principal stresses, normal and shear stress, Mohr's circle and its application to two and three dimensional analyses, Ductile and brittle failures, Transmission shaft under combined bending and torsion, Stresses in thin walled pressure vessel.

UNIT III:

Differential equation of the deflection curve, Deflections by integration, Moment area method, First Moment-Area Theorem, Second Moment-Area Theorem, Introduction to columns, Buckling and stability Differential Equation for Column Buckling, Pinned-pinned column, Columns with other support conditions, Column with eccentric load, Ranking formula for Column

UNIT VI:

Torsion in shafts: stresses in a shaft, deformation in circular shaft, angle of twist, Stepped-hollow, thin walled-hollow transmission shafts, Leaf springs; helical springs, open and closed coil, stress in spring wire, Deflection of helical spring, springs in series and parallel

UNIT V:

Theories of failures: maximum normal stress & shear stress theory, Maximum normal and shear strain energy theory, Maximum distortion energy theory; application of theories to different

materials and loading conditions, Columns: stability of structures, Euler's formula for columns with different end conditions, Rankin's formula.

Text Books-

1. Strength of Materials, R.K. Bansal, Laxmi Publications (6th Ed., 2018).
2. Strength of Materia, S. Ramamrutham, Dhanpat Rai Publications (2017 Ed.).
3. Strength of Materials, S. S. Bhavikatti, Vikas Publishing (2019 Ed.).
4. Strength of Materials (Mechanics of Solids), S. Chandrasekharaiah & L. N. Srinath, Universities Press (Revised 4th Ed., 2010).
5. Strength of Materials, Timoshenko, Stephen P, CBS Publishers / McGraw-Hill (Reprint 2017, 4th Ed.).

Reference Books-

1. Strength of Materials, Ferdinand L. Singer & Andrew Pytel, HarperCollins / McGraw-Hill (4th Ed., 1998).
2. Mechanics of Materials, Ferdinand Beer, E. Russell Johnston, John T. DeWolf, David F. Mazurek, McGraw-Hill (8th Ed., 2017).
3. Mechanics of Materials, R.C. Hibbeler, Pearson (11th Ed., 2015).
4. Strength of Materials, R.K. Rajput, S. Chand Publishing (5th Ed., 2015).
5. Strength of Materials, B.C. Punmia & Ashok Kumar Jain, Laxmi Publications (2017 Ed.).

In this lab Experiments as given below:

Experiments on Material testing (at least 5 of the following):

1. Strength test of a given mild steel specimen on UTM with full details and stress versus strain plot on the machine.
2. Other tests such as shear bend tests on UTM.
3. Impact test on impact testing machine like Charpy, Izod or both.
4. Hardness test of given specimen using Rockwell and Vickers/Brinell testing machines.
5. Spring index test on spring testing machine.
6. Fatigue test on fatigue testing machine.
7. Creep test on creep testing machine.
8. Experiment on deflection of beam, comparison of actual measurement of deflection with dial gauge to the calculated one, and or evaluation of young's modulus of beam.
9. Torsion test of a rod using torsion testing machine.
10. Study of NDT (non-destructive testing) methods like magnetic flaw detector, ultrasonic flaw detector, eddy current testing machine, dye penetrant tests.

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Name of Program	**Bachelor of Technology (Mechanical Engineering)**				
BME3005/BME3055	**Primary Manufacturing/Primary Manufacturing Lab**	L	T	P	C
Owning School/Department	**Mechanical Engineering**	3	0	2	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: To Understand and Analyze the importance of manufacturing for humankind, Hot and Cold Working, Rolling, Forging, Extrusion and Drawing Processes.
CO2: Understand Design and Analyze different sheet metal working processes
CO3: Understand and Analyze foundry practices like pattern making, mold making, Core making and Inspection of defects.
CO4: Understand different plastic molding processes, Extrusion of Plastic and Thermoforming
CO5: Understand different Welding and joining processes and its defects.

Course Contents:

UNIT I:
Importance of manufacturing, Economic & technological considerations in manufacturing, Classification of manufacturing processes, Metal Forming Processes, Elastic & plastic deformation, Equilibrium equation method, Work required for forging, Hand, Power, Drop Forging

UNIT II:

Drawing and Extrusion: Tube drawing, Extrusion and its application, Analysis of Wire/strip drawing and maximum-reduction, Condition for Rolling force and power in rolling, Rolling mills & rolled-sections, Design, lubrication and defects in metal forming processes

UNIT III:

Sheet Metal Working: Presses and their classification Die & punch assembly and press work methods and processes, Cutting/Punching mechanism, Blanking vs. Piercing, Compound vs. Progressive die, Flat-face vs. Inclined-face punch and Load (capacity) needed, Analysis of forming process like cup/deep drawing, Bending & spring-back

UNIT IV:

Unconventional Metal forming processes-explosive forming, electromagnetic, electro-hydraulic forming, Powder metallurgy manufacturing process, Locating & Clamping devices & principles, Jigs and Fixtures and its applications

UNIT V:

Casting (Foundry): Basic principle & survey of casting processes, Types of patterns and allowances, Types and properties of moulding sand, Elements of mould and design considerations, Gating, Riser, Runners, Core, Solidification of casting, Sand casting, defects & remedies and inspection, Die Casting, Centrifugal casting. Investment casting, CO2 casting and Stir casting

Text Books

1. Manufacturing Processes, P.C. Sharma, S. Chand Publishing (11th Ed., 2018).
2. Manufacturing Science, A. Ghosh & A.K. Mallik, East-West Press (2nd Ed., 2010).
3. Production Technology (Manufacturing Processes), R.K. Jain, Khanna Publishers (17th Ed., 2012).
4. Manufacturing Processes for Engineering Materials, erope Kalpakjian & Steven Schmid, Pearson (6th Ed., 2017).
5. Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, Mikell P. Groover, Wiley (7th Ed., 2019).

Reference Books:

1. Manufacturing Processes and Materials, George Dieter & Paul Degarmo (often listed as Materials and Processes in Manufacturing), Wiley (11th Ed., 2019).
2. Production Technology, HMT (Hindustan Machine Tools) Staff, Tata McGraw-Hill (2001 Reprint).
3. Manufacturing Processes (Vol I & II), H.S. Bawa, McGraw-Hill Education (2012).
4. Workshop Technology (Vol I, II, III), Hazra Chowdhury, Media Promoters & Publishers (2010 Ed.)
5. Manufacturing Technology (Vol. I & II), P.N. Rao, McGraw-Hill Education (5th Ed., 2013).

Note: Minimum Eight Experiments Out of Following

1. Design of pattern for a desired casting (containing hole)
2. Pattern making
3. Making a mould (with core) and casting.
4. Sand testings (at least one such as grain fineness number determination)
5. Injection moulding with plastics
6. Forging hand forging processes
7. Forging - power hammer study & operation
8. Tube bending with the use of sand and on tube bending m/c.
9. Press work experiment such as blanking/piercing, washer, making etc.
10. Wire drawing/extrusion on soft material.
11. Rolling-experiment.
12. Bending & spring back.
13. Powder metallurgy experiment.
14. Jigs & Fixture experiment.

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Name of Program	Bachelor of Technology (Mechanical Engineering)				
BME3006/BME3056	Theory of Machines/ Theory of Machines Lab	L	T	P	C
Owning School/Department	Mechanical Engineering	2	0	2	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1 : calculate Degrees of Freedom (DoF) of various mechanisms identify basic mechanism of machine and construct its inversions also draw their velocity and acceleration image.
CO2 : sketch cam profile &compute various parameters involved in gear system.
CO3 : Perform force analysis in various mechanism.
CO4 : Analyze balancing problems in rotating and reciprocating machinery & understand various governors.
CO5 : Understand basic behind brakes and dynamometer.

Course Contents:

UNIT I:

Introduction to mechanisms and machines, kinematics and kinetics, types of links, Kinematic pairs and their classification, types of constraint, Degrees of freedom of planar mechanism, Grubler's equation, Mechanisms, inversion of four bar chain, Slider crank chain and double slider crank chain, Velocity analysis: Introduction, velocity of point in mechanism, relative velocity method, Velocities in four bar mechanism, instantaneous center, Acceleration analysis: Introduction, acceleration of a point on a link, acceleration diagram, Coriolis component of acceleration, crank and slotted lever mechanism.

UNIT II:

Cams: Introduction, classification of cams and followers, Cam profiles for knife edge, roller and flat faced followers for uniform velocity, uniform acceleration, Gears and gear trains Introduction, classification of gears, Law of gearing, tooth forms and their comparisons, systems of gear teeth, Length of path of contact, contact ratio, Minimum number of teeth on gear and pinion to avoid interference, Simple, compound, reverted and planetary gear trains, Sun and planet gear train.

UNIT III:

Static force analysis of mechanisms, D'Alembert's Principle, Dynamics of rigid link in plane motion, dynamic force analysis of planar mechanisms, Piston force and crank effort, Turning moment on crankshaft due to force on piston, Turning moment diagrams for single cylinder double acting steam engine, four stroke IC engine and multi-cylinder engines, Fluctuation of speed, Flywheel.

UNIT IV:

Balancing: Introduction, static balance, dynamic balance, balancing of rotating masses, two plane balancing, graphical and analytical methods, balancing of reciprocating masses, Governors: Introduction, types of governors, characteristics of centrifugal governors, Gravity controlled and spring controlled centrifugal governors, Hunting of centrifugal governors, inertia governors. Effort and Power of governor

UNIT V:

Brakes: Introduction, Law of friction and types of lubrication, Types of brakes, effect of braking on rear and front wheels of a four-wheeler, Dynamometers: belt transmission dynamometer, torsion dynamometer, hydraulic dynamometer

Text books

1. Theory of Machines, R.S. Khurmi & J.K. Gupta, S. Chand Publishing (14th Ed., 2015).
2. Theory of Machines, S.S. Rattan, McGraw-Hill Education (5th Ed., 2019).
3. Theory of Machines and Mechanisms, John J. Uicker Jr., Gordon R. Pennock, Joseph E. Shigley, Oxford University Press (4th Ed., 2010).
4. Kinematics and Dynamics of Machinery, Charles E. Wilson & J. Peter Sadler, Pearson (3rd Ed., 2003).
5. Kinematics and Dynamics of Machinery, Robert L. Norton, McGraw-Hill (2nd Ed., 2008).

Reference Books:

1. Theory of Machines, Thomas Bevan, CBS Publishers (Reprint, 2010, Original UK Edition).
2. Mechanism and Machine Theory, J.S. Rao & R.V. Dukkipati, New Age International Publishers (2nd Ed., 2006).
3. Mechanics of Machines, Cleghorn W.L., Oxford University Press (2nd Ed., 2015).
4. Kinematics and Dynamics of Machines, G.H. Martin, McGraw-Hill (2nd Ed., 1982).
5. Theory of Machines, P.L. Ballaney, Khanna Publishers (2013 Ed.).

List of Experiments:

Note: Eight experiments out of the following are to be conducted

1. Study of simple linkage models/mechanisms
2. Study of inversions of four bar linkage
3. Study of inversions of single/double slider crank mechanisms
4. Experiment on Gears tooth profile, interference etc.
5. Experiment on Gear trains
6. Experiment on longitudinal vibration
7. Experiment on transverse vibration
8. Experiments on dead weight type governor
9. Experiment on spring controlled governor
10. Experiment on critical speed of shaft
11. Experiment on gyroscope
12. Experiment on static/dynamic balancing
13. Experiment on Brake
14. Experiment on clutch

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Semester-IV

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Name of Program	Bachelor of Technology (Mechanical Engineering)				
BME4001/ BME4051	Applied Thermal Engineering/ Thermal Engineering Lab	L	T	P	C
Owning School/Department	Mechanical Engineering	3	1	2	5
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: apply various concepts of gas power cycle and calculate, numerical related to testing of IC engine.
CO2: sketch charts &compute, performance parameters of Rankine cycle and its modification.
CO3: calculate Air-Fuel ratio and composition of fuel and Flue gases.
CO4: apply concepts learned in steam & gas nozzles and steam turbine.
CO5: Understand the testing of I. C. Engines and analyze its performance

Course Contents:

UNIT I:

Mathematical conditions for exact differentials, Maxwell Relations, Clapeyron Equation, Joule-Thompson coefficient and Inversion curve, Coefficient of volume expansion, Adiabatic & Isothermal compressibility, Combustion analysis, Heating Values, Air requirement, Air/Fuel ratio, Standard heat of Reaction, Effect of temperature on standard heat of reaction, Heat of formation, Adiabatic flame temperature

UNIT II:

Boiler: Steam generators-classifications. Working of fire-tube boiler, Working of water-tube boiler, Boiler mountings & accessories, Draught & its calculations, air pre heater, feed water heater, super heater, Boiler efficiency, Equivalent evaporation, Boiler trial and heat balance, Classification of condenser, Air leakage, Condenser performance parameter

UNIT III:

Steam and Nozzle: Rankine and modified Rankine cycles, Working of stream engine, Classification of steam engine, Indicator diagram, Saturation curve, Missing quantity, Heat balance, Flow through nozzle, Variation of velocity, Area and specific volume, Choked flow, Throat area, Nozzle efficiency, Off design operation of nozzle, Effect of friction on nozzle, Super saturated flow

UNIT IV:

Vapour Power Cycle: Carnot vapour power cycle, Effect of pressure & temperature on Rankine cycle, Binary vapour cycle, Combined cycles, Cogeneration, Steam Turbine: Classification of steam turbine, Impulse and reaction turbines, Calculations work done efficiencies of reaction, Impulse reaction Turbines, state point locus, Losses in steam turbines, Governing of turbines

UNIT V:

Gas Turbine: Gas turbine classification Brayton cycle, Principles of gas turbine, Jet Propulsion: Principles of jet propulsion, Turbojet and turboprop engines & their processes, Compressors: Classification, Reciprocating compressors, Single and Multi-stage compressors

Text Books:

1. Applied Thermodynamics, Onkar Singh, New Age International Publishers (2009 Ed.).
2. Applied Thermodynamics, R.K. Rajput, Laxmi Publications (2017 Ed.).
3. Applied Thermodynamics for Engineering Technologists, T.D. Eastop & A. McConkey, Pearson Education (5th Ed., 1993).
4. Fundamentals of Engineering Thermodynamics, Moran, Shapiro, Boettner & Bailey, Wiley (9th Ed., 2018).
5. Thermal Engineering, R.K. Rajput, Laxmi Publications (2010 Ed.).

Reference Books:

1. Thermal Engineering, P.L. Ballaney, Khanna Publishers (2010 Ed.).
2. Thermal Engineering, R.S. Khurmi & J.K. Gupta, S. Chand Publishing (2011 Ed.).
3. Heat Engines, V. Ganeshan, Tata McGraw-Hill (2010 Ed.).
4. Applied Thermodynamics, Domkundwar & C.P. Kothandaraman, Dhanpat Rai Publishing (2016 Ed.).
5. Fundamentals of Classical Thermodynamics, Van Wylen, Sonntag & Borgnakke, Wiley (1994, older eds).

Experiments: Minimum five experiments out of following;

1. Study of Fire Tube boiler
2. Study of Water Tube boiler
3. Study of Velocity compounded steam turbine
4. Study of Pressure compounded steam turbine
5. Study of Impulse & Reaction turbine
6. Study of steam Engine model.
7. Study of Gas Turbine Model
8. Any other suitable experiment on thermodynamics

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BME4002	Design of Machine Elements	L	T	P	C
Owning School/Department	Mechanical Engineering	3	1	0	4
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1 : Compute the stress acting on various machine elements.
CO2 : Compute the dimensions, stress requirements of shaft and couplings based on various load conditions.
CO3 : Summarize about temporary and permanent joints based on application requirements.
CO4 : Compute the dimensions of the energy storing devices for specific applications.
CO5 : Predict appropriate bearing, from the standard catalog for varied applications.

Course Contents:

UNIT I:

Stress concentration and fatigue: causes of stress concentration; stress concentration in tension, bending and torsion, Reduction of stress concentration, theoretical stress concentrationfactor, notch sensitivity, Fatigue stress concentration factor, cyclic loading, endurance limit, S-NCurve, loading factor, size factor, surface factor, Design consideration for fatigue, Goodman and modified Goodman's diagram, Soderberg equation, Gerber parabola, Design for finite life, cumulative fatigue damage factor.

UNIT II:

Design of shaft under combined bending, twisting and axial loading, Shock and fatigue Factors, design for rigidity, Design of shaft subjected to dynamic load, Design of keys and shaft Couplings.

UNIT III:

Springs: Design of helical compression and tension springs, Consideration of dimensional and functional constraints, leaf springs and torsion springs, Fatigue loading of springs, surge in spring, Design of simple and power screw jack, and power nut.

UNIT IV:

Brakes & Clutches: Materials for friction surface, uniform pressure and uniform wear theories, Design of friction clutches: Disk, plate clutches, cone & centrifugal clutches, Design of brakes: Rope, band & block brake, Internal expending brakes, Disk brakes.

UNIT V:

Journal Bearing: Types of lubrication, viscosity, hydrodynamic theory, design factors, temperature and viscosity considerations, Reynold's equation, stable and unstable operation, Heat dissipation and thermal equilibrium, boundary lubrication, dimensionless numbers, Design of journal bearings, Rolling-element Bearings: Types of rolling contact bearing, bearing friction and power loss, Bearing life; Radial, thrust & axial loads; Static & dynamic load capacities, Selection of ball and roller bearings; lubrication and sealing

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BCN3001	Differential Calculas	L	T	P	C
Owning School/Department	Mechanical Engineering	3	1	0	4
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Convergenceanddivergenceofsequenceandseries.
CO2: Continuity, differentiability and integrability for functions of one variable and multivariables. Approximating the smooth function with a polynomial
CO3: Computing the area and volume of functions up to three variables.
CO4: Solving the problems using computational software packages.

Course Contents:

UNIT I:

Functions, intuitive idea of limits, formal definition -$\epsilon-\delta$, continuity, Intermediate Value Theorem., Derivative: Geometric Interpretation, Limit definition of derivative, tangent lines, velocity, rates of change, Differentiation Rules: Power, Sum, Product, Quotient, derivative formulas, linearity, Derivatives of Trigonometric, Exponential, and Logarithmic Functions, Standard derivatives, proofs using limit definition or rules, Chain Rule, Differentiating composite functions, Implicit Differentiation, Technique for functions defined implicitly, Higher Order Derivatives, Second and higher derivatives, concavity, acceleration.

UNIT II:

Related Rates, Solving problems involving rates of change of related quantities, Extrema of Functions: Critical Points and First Derivative Test, Finding local maxima and minima, increasing/decreasing functions, Concavity and Second Derivative Test, Determining concavity, points of inflection, classifying extrema, Optimization Problems, Setting up and solving applied maximum/minimum problems, Optimization Problems, More complex optimization examples across disciplines, Mean Value Theorem and L'Hôpital's Rule, Lagrange MVT statement and significance, L'Hôpital's rule for indeterminate forms -$0/0, \infty/\infty$, Taylor and Maclaurin Series, Taylor polynomials for approximation, Taylor/Maclaurin series representation.

UNIT III:

Antiderivatives and Indefinite Integrals, Concept of antiderivative, integration formulas, initial value problems, Definite Integral: Riemann Sums, Area under curve, limit of Riemann sums, properties of definite integrals, Fundamental Theorem of Calculus, Connecting differentiation and integration, Integration by Substitution, Reversing chain rule for integration, Integration by Parts, Reversing product rule, Integration of Rational Functions by Partial Fractions, Technique for integrating rational functions.

UNIT IV:

Applications of Integration: Area Between Curves, Calculating areas of regions bounded by functions, Applications of Integration: Volumes -Disks/Washers, Shells, Calculating volumes of solids of revolution, 3D Coordinates and Vectors, Cartesian coordinates in 3D, vectors,

vector addition, scalar multiplication, Dot Product and Projections, Definition and properties of dot product, angle between vectors, vector projections, Cross Product and Geometric Applications, Definition and properties of cross product, area of parallelogram, volume of parallelepiped, Functions of Several Variables and Level Curves/Surfaces, f-x,y, f-x,y,z, domain, range, level curves/surfaces, Partial Derivatives, calculation, geometric interpretation -slopes on surfaces.

UNIT V:

1. Chain Rule for Multivariable Functions, Chain rule with multiple independent/intermediate variables.
2. Directional Derivatives and Gradient Vector, Rate of change in arbitrary directions, definition and properties of ∇f.
3. Tangent Planes and Linear Approximations, Equation of tangent plane, linear approximation f-x,y≈f-a,b+∇f-a,b·⟨x−a,y−b⟩.
4. Maxima and Minima for Functions of Several Variables, Critical points, second derivative test for f-x,y.
5. Lagrange Multipliers, Constrained optimization problems.

UNIT VI:

1. ODEs; Separable and First-Order Linear Equations, Terminology, modeling examples, solution techniques.
2. Exact Equations and Integrating Factors, Test for exactness, method of solution, finding integrating factors.
3. Second-Order Linear Homogeneous ODEs with Constant Coefficients, Characteristic equation, cases of real distinct, real repeated, complex roots.
4. Second-Order Linear Non-Homogeneous ODEs: Undetermined Coefficients, Solving ay″+by′+cy=g-x for polynomial, exponential, trig g-x.
5. Second-Order Linear Non-Homogeneous ODEs: Variation of Parameters, General method for non-homogeneous equations.

Text Books:

1. Weir, Maurice D., Joel Hass, and Frank R. Giordano. *Thomas' calculus*. 14th ed. Pearson Education India, 2018.ISBN9789353060411.
2. Ross, Kenneth A. *Elementary Analysis the Theory of calculus*. 2nd ed. Springer publication, 2013. ISBN978-1461462705.

Reference Books:

1. Stewart, James. *Calculus*. 7th ed. Cengage Learning, 2012.ISBN 0538497815.
2. Ghorpade, Sudhir R., and Balmohan Vishnu Limaye. *A course in calculus and real analysis*. 1st ed. New York: Springer, 2006. ISBN978-0387305300.
3. Bartle, Robert G., and Donald R. Sherbert. *Introduction to real analysis*. 4th ed. New York: Wiley, 2014. ISBN812655181X.
4. Kreyszig, Herbert, and Erwin Kreyszig. *Advanced Engineering Mathematics, Student Solutions Manual and Study Guide*. 10th ed. John Wiley & Sons, 2010. ISBN978-8126554232.

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Name of Program	Bachelor of Technology (Mechanical Engineering)				
BME3002/BME3052	Engineering Thermodynamics/ Engineering Thermodynamics Lab	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	2	4
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Apply various laws of thermodynamics to various processes and real systems.
CO2: Apply the concept of Entropy, Calculate heat, work and other important thermodynamic properties.
CO3: Find Estimate performance of various Thermodynamic gas power cycles.

Course Contents:

UNIT I: Fundamental Concepts and Definitions:

Introduction and definition of thermodynamics, Systems, surroundings and universe, Microscopic and Macroscopic approaches, Concept of continuum, Control system boundary, Properties and state, Thermodynamic properties, Thermodynamic path, process and cycle, Thermodynamic equilibrium, Reversibility and irreversibility, Quasi static process, Energy and its forms, Work and heat, Gas laws, Ideal gas, Real gas, Law of corresponding states, Property of mixture of gases, Zeroth law of thermodynamics, Temperature and its' measurement, Temperature scales

UNIT II: First law of thermodynamics

Thermodynamic definition of work, thermodynamic processes, Calculation of work in various processes and sign convention, Non-flow work and flow work, Joules' experiment, First law of thermodynamics, Internal energy and enthalpy, first law of thermodynamics applied to open systems, Steady flow systems and their analysis, Steady flow energy equation, Boilers, Condensers, Turbine, Throttling process, Pumps etc, First law analysis for closed system (non flow processes), Analysis of unsteady processes such as filling and evacuation of vessels with and without heat transfer, Limitations of first law of thermodynamics, PMM-I

UNIT III: Second law

Devices converting heat to work, Thermal reservoir, Heat engines, Efficiency, Devices converting work to heat, Heat pump, refrigerator, Coefficient of Performance, Reversed heat engine, Kelvin Planck statement of second law of thermodynamics, Clausius statement of second law of thermodynamics, Equivalence of two statements of second law of thermodynamics, Reversible and irreversible processes, Carnot cycle and Carnot engine, Carnot theorem and its corollaries, thermodynamic temperature scale, PMM-II.

UNIT IV: Entropy, Availability and Irreversibility

Clausius inequality, Concept of Entropy, Entropy change in different thermodynamic processes, Tds equation, Principle of entropy increase, T-S diagram, Statement of the third law

of thermodynamics, Available and unavailable energy, Availability and Irreversibility, Second law efficiency, Helmholtz & Gibb's function

UNIT V: Properties of steam and thermodynamics cycles

Pure substance, Property of steam, Triple point, Critical point, Sub-cooled liquid, Saturation states, Superheated states, Phase transformation process of water, Graphical representation of pressure, volume and temperature, P-T & P-V diagrams, T-S and H-S diagrams, use of property diagram, Steam-Tables & Mollier charts, Dryness factor and its measurement, processes involving steam in closed and open systems, Simple Rankine cycle

Text Books-

1. Engineering Thermodynamics, J.B. Jones & R.E. Dugan, PHI Learning Pvt. Ltd. (Indian Reprint, 2011)
2. Fundamentals of Thermodynamics by Sonntag, Wiley India Pvt. Ltd.
3. Engineering Thermodynamics by Onkar Singh, New Age International Pub.
4. Thermodynamics: An Engineering Approach, Yunus A. Çengel & Michael A. Boles, McGraw-Hill (9th Ed., 2021).
5. Fundamentals of Thermodynamics, Richard E. Sonntag, Claus Borgnakke, Gordon J. Van Wylen, Wiley (8th Ed., 2012).

Reference Books-

1. A Textbook of Thermodynamics, J.P. Holman, McGraw-Hill (9th Ed., 2002).
2. Engineering Thermodynamics by P.K. Nag, Tata McGraw Hill Pub, (5th Ed., 2013).
3. Engineering Thermodynamics, J.B. Jones & R.E. Dugan, PHI Learning Pvt. Ltd. (Indian Reprint, 2011).
4. Applied Thermodynamics for Engineering Technologists, T.D. Eastop & A. McConkey, Pearson (5th Ed., 1993).
5. Engineering Thermodynamics, R.K. Rajput, Laxmi Publications (5th Ed., 2010).

List of Experiments:

1. Study of model of Babcock &Wilcox Boiler
2. Study of model of Lancashire boiler
3. Study and working of four stroke petrol engine.
4. Study and working of four stroke diesel engine
5. Study and working of two stroke diesel engine
6. Study and working of two stroke petrol engine
7. Study the working of steam turbine model.

Text Books:

1. Design of Machine Elements, V.B. Bhandari, McGraw-Hill Education (4th Ed., 2016).
2. Mechanical Engineering Design, J.E. Shigley, Richard G. Budynas, Keith J. Nisbett, McGraw-Hill Education (10th Ed., 2015).
3. Machine Design: An Integrated Approach, Robert L. Norton, Pearson (5th Ed., 2013).
4. Machine Design, S. Md. Jalaludeen, Anuradha Publications (2014 Ed.).
5. Deutschman, D., Michels, W.J. and Wilson, C.E., Machine Design Theory and Practice, Macmillan, 1992.

Reference Books:

1. Design of Machine Elements, Sharma & Purohit, Prentice Hall India (2015 Ed.).
2. Machine Design, P.C. Gope, PHI Learning Pvt. Ltd. (2012 Ed.).
3. Fundamentals of Machine Component Design, Robert C. Juvinall & Kurt M. Marshek, Wiley (6th Ed., 2016).
4. Machine Design, Dr. Sadhu Singh, Khanna Publishers (2011 Ed.).
5. Design of Machine Elements, J.B. K. Das & P.L. Srinivasa Murthy, Sapna Book House (2012 Ed.).

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BME4003/ BME4053	Measurement & Metrology/ Measurement & Metrology Lab	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	2	4
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: explain of basics of Measurements & measurement systems.
CO2: identify the working of time, pressure a strain measuring instruments.
CO3: explain functioning of Accelerometers and vibrometers.
CO2: understand the principle of limit, fits & tolerances and identify the working of Limit gauges.
CO3: explain the basics of measurement of geometric forms and instruments.

Course Contents

UNIT-I:

Introduction: Introduction to measurement and measuring instruments, Generalized measuring system and functional elements, UNITs of measurement, static and dynamic performance characteristics of measurement devices, Calibration, concept of error, sources of error, statistical analysis of errors, Sensors and Transducers: Types of sensors, types of transducers and their characteristics.

UNIT-II:

Signal transmission and processing: Devices and systems, Signal Display & Recording Devices, Time related measurements: Counters, stroboscope, frequency measurement by direct comparison, Measurement of displacement, Measurement of pressure: Gravitational, directing acting, Elastic and indirect type pressure transducers, Measurement of very low pressures.

UNIT-III:

Strain measurement: Types of strain gauges, their working, strain gauge circuits, Temperature compensation. Strain rosettes, calibration, Measurements of force and torque: Different types of load cells, Elastic transducers, pneumatic& hydraulic systems, Temperature measurement: Thermometers, bi metallic thermocouples, Thermistors and pyrometers., decibel meters, Vibration: Seismic instruments, vibration pickups, Vibrometers, accelerometers.

UNIT-IV:

Metrology Metrology and Inspection: Standards of linear measurement, line and end standards. Limit fits and tolerances, Interchangeability and standardization, Linear and angular measurements devices and systems Comparators, Sigma, Johansson's Microkrator, Limit gauges' classification, Taylor's Principle of Gauge Design.

UNIT-V:

Measurement of geometric forms like straightness, flatness, roundness, Tool makers microscope, profile project autocollimator, Interferometry: principle and use of interferometry,

optical flat. Measurement of screw threads and gears, Surface texture: quantitative evaluation of surface roughness and its measurement, Measurement and Inspection: Dimensional inspection, Tolerance, Limit gauging, comparators, Surface roughness, Feature inspection.

Text Books:

1. Engineering Metrology & Measurements, R.K. Jain, Khanna Publishers (17th Ed., 2016).
2. Engineering Metrology & Measurements, N.V. Raghavendra & L. Krishnamurthy, Oxford University Press (2013, Reprint 2018).
3. A Textbook of Engineering Metrology, I.C. Gupta, Dhanpat Rai & Co. (2012 Ed.).
4. Engineering Metrology, K.J. Hume, Macdonald & Evans (Latest Reprint).
5. Metrology & Measurement, Anand Bewoor & Vinay Kulkarni, McGraw-Hill Education (2013 Ed.).

Reference Books:

1. Engineering Metrology, M.S. Mahajan, Dhanpat Rai Publishing (2010 Ed.).
2. Engineering Metrology and Measurements, Raghavendra & Krishnamurthy, Oxford University Press (2018 Ed.).
3. Dimensional Metrology, C. Donaldson, Sir Isaac Pitman & Sons.
4. Introduction to Measurements and Instrumentation, Arun K. Ghosh, PHI Learning (4th Ed., 2012).
5. Mechanical Measurements, Thomas G. Beckwith, Roy D. Marangoni, John H. Lienhard, Pearson Education (6th Ed., 2007).

List of Experiments:

Note: minimum 5 experiments out of the following

1) Study & working of simple measuring instruments- Vernier calipers, micrometer, tachometer
2) Measurement of effective diameter of a screw thread using 3 wire methods
3) Measurement of angle using sinebar & slip gauges. Study of limit gauges
4) Study & angular measurement using level protector
5) Adjustment of spark plug gap using feeler gauges
6) Study of dial indicator & its constructional details
7) Use of dial indicator to check a shape run use
8) Study and understanding of limits, fits & tolerances
9) Study of Pressure & Temperature measuring equipment.
10) Strain gauge measurement.

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Name of Program	Bachelor of Technology (Mechanical Engineering)				
BME4004/ BME4056	Machine Tool & Machining/ Machine Tool & Machining Lab	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	2	4
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1 : Explain Basics of Metal Cutting and solve the numerical based on Merchant Force circle diagram.
CO2 : Explain operation of lathe, milling machines, drill process and solve the numerical based on Up-milling and down-milling.
CO3 : Explain super finishing and grinding Process and recognize grinding wheel Specifications.
CO4 : Explain metal joining
CO5 : Explain Unconventional Machining and Welding

Course Contents

UNIT-I:

Mechanics of metal cutting, Geometry of tool and nomenclature, ASA system Orthogonal vs. oblique cutting, Mechanics of chip formation, types of chips, Shear angle relationship, Merchant's force circle diagram. Cutting forces, power required, Cutting fluids/lubricants, Tool materials, Tool wear and tool life, Mach inability, Dynamometer, Brief introduction to machine tool vibration and surface finish, Economics of metal cutting.

UNIT-II:

Machine Tools Lathe: Principle, construction, types, operations, Turret/capstan, Semi/Automatic, Tool layout, Shaper, slotter, planer: Construction, operations & drives, milling: Construction, milling cutters, up & down milling. Dividing head & indexing. Max chip thickness & power required, Drilling and boring: Drilling, boring, reaming tools. Geometry of twist drills.

UNIT-III:

Grinding & super finishing, Grinding: Grinding wheels, abrasive & bonds, cutting action, Grinding wheel specification. Grinding wheel wear - attritions wear, fracture wears, Dressing and Truing. Max chip thickness and Guest criteria. Surface and cylindrical grinding, Center less grinding. Super finishing: Honing, lapping, and polishing

UNIT-IV:

Metal Joining (Welding), Survey of welding and allied processes, Gas welding and cutting, process and equipment. Arc welding: Power sources and consumables, TIG & MIG processes and their parameters, Resistance welding - spot, seam projection etc. Other welding processes such as atomic hydrogen, submerged arc, electro slag, friction welding. Soldering & Brazing,

Thermodynamic and Metallurgical aspects in welding and weld, Shrinkage/residual stress in welds. Distortions & Defects in welds and remedies, Weld decay in HAZ.

UNIT-V:

Tool Design: Jigs & Fixtures: Locating & Clamping devices & principles, Jigs and Fixtures and its applications.

Text Books

1. Manufacturing Processes, P.C. Sharma, S. Chand Publishing (11th Ed., 2018).
2. Manufacturing Science, A. Ghosh & A.K. Mallik, East-West Press (2nd Ed., 2010).
3. Production Technology (Manufacturing Processes), R.K. Jain, Khanna Publishers (17th Ed., 2012).
4. Manufacturing Processes for Engineering Materials, erope Kalpakjian & Steven Schmid, Pearson (6th Ed., 2017).
5. Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, Mikell P. Groover, Wiley (7th Ed., 2019).

Reference Books:

1. Manufacturing Processes and Materials, George Dieter & Paul Degarmo (often listed as Materials and Processes in Manufacturing), Wiley (11th Ed., 2019).
2. Production Technology, HMT (Hindustan Machine Tools) Staff, Tata McGraw-Hill (2001 Reprint).
3. Manufacturing Processes (Vol I & II), H.S. Bawa, McGraw-Hill Education (2012).
4. Workshop Technology (Vol I, II, III), Hazra Chowdhury, Media Promoters & Publishers (2010 Ed.)
5. Manufacturing Technology (Vol. I & II), P.N. Rao, McGraw-Hill Education (5th Ed., 2013).

List of Experiments:

Milling and slotting machine tool

- To make a gear profile on milling machine and prepare slots as key ways using slotter machine tool.

Shaper and grinding machine tool

- To prepare a V block on shaper machine and improvement in quality using surface grinder.

Turret and Capston machine tool

- To prepare a multi operational job on turret and capstone.
- To prepare a multi operational job on capston lathe machine.

Lathe machine tool

- To prepare a typical job using various operations of lathe machine.

Measurement

- Measurement using Vernier caliper, Micrometer, Height Gauge and to find the run-out error using Dial

Indica tor

- Angle measurement using Bevel Protractor, Sine bar and to measure surface roughness of the given specimen.
- Measurement of Screw thread and spur gear using Profile Projector.
- Measurement of bores by using bore gauge instrument

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Name of Program	**Bachelor of Technology (Mechanical Engineering)**				
BME4005/ BME4055	**Electrical Machines & Control Theory/ Electrical Machines & Control Theory Lab**	L	T	P	C
Owning School/Department	**Mechanical Engineering**	3	0	2	4
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Understand electrical principle, laws, and working of 1 phase transformer and losses and also conduct various tests on the transformer.
CO2: Analyze the construction and characteristics and application of various type of DC Machines & generator.
CO3: Analyze construction and application of Synchronous Machines and Induction Machines.
CO4: Construct the mathematical model of system from differential equation and vice versa.
CO5: Understand the Time Response and Frequency Response of the Systems.

Course Contents:

UNIT I:

Single phase Transformer: Efficiency Voltage regulation, O.C.& S.C. Tests, **Three Phase Transformer:** Three phase transformer connections, 3-phase to 2-phaseOr 6-phase connections and their applications, **Auto Transformer:** Volt- Amp relations, efficiency, advantages & disadvantages, applications, **D.C. Motors:** Concept of starting, speed control, losses and efficiency

UNIT II:

Three phase Induction Motor: Construction, equivalent circuit, torque equation and torque-slip characteristics, speed control, **Alternator:** Construction, e.m.f. equation, Voltage regulation and its determination by synchronous impedance method, **Synchronous Motor:** Starting, effect of excitation on line current (V-curves), synchronous condenser, **Servo Motor:** Two phase a.c. servo motor & its application.

UNIT III:

Modeling of Mechanical System: linear mechanical elements, force-voltage and force current analogy, electrical analog of simple mechanical systems; concept of transfer function & its determination for simple systems, **Control System:** Open loop & closed loop controls, servo mechanisms; concept of various types of system. **Signals:** UNIT step, UNIT ramp, UNIT impulse and periodic signals with their mathematical representation and characteristics.

UNIT IV:

Time Response Analysis: Time response of a standard second order system and response specifications, steady state errors and error constants, **Stability:** Concept and types of stability,

Routh Hurwitz Criterion and its application for determination of stability, limitations; Polar plot, Nyquist stability Criterion and assessment of stability.

UNIT V:

Root Locus Techniques: Concept of root locus, construction of root loci, **Frequency Response Analysis:** Correlation between time and frequency responses of a second order system; Bode plot, gain margin and phase margin and their determination from Bode and Polar plots. **Process control:** Introduction to P, PI and PID controllers their characteristics, representation and applications

Text Books-

1. Electrical Machinery, P.S. Bimbhra, Khanna Publishers (7th Ed., 2011).
2. Electrical Machines, D.P. Kothari & I.J. Nagrath, Tata McGraw-Hill (4th Ed., 2010).
3. Electric Machinery, A.E. Fitzgerald, Charles Kingsley Jr., Stephen Umans, McGraw-Hill Education (7th Ed., 2013).
4. Electrical Machines, S.K. Bhattacharya, McGraw-Hill Education (3rd Ed., 2011).
5. Performance and Design of AC Machines, M.G. Say, CBS Publishers (Reprint Ed.).

Reference Books-

1. B.C. Kuo, "Automatic Control systems." Wiley India Ltd
2. B.R. Gupta &VandanaSinghal, "Fundamentals of Electrical Machines", New Age International.
3. K. Ogata, "Modern Control Engineering" Prentice Hall of India.
4. Automatic Control Systems, Benjamin C. Kuo, Farid Golnaraghi, Wiley (9th Ed., 2014).
5. Modern Control Engineering, Katsuhiko Ogata, Pearson (5th Ed., 2010).

Experiments: Minimum five experiments out of following;

A. Electrical Machines

1. To obtain speed-torque characteristics and efficiency of a dc shunt motor by direct loading.
2. To obtain efficiency of a dc shunt machine by no load test.
3. To obtain speed control of dc shunt motor using (a) armature voltage control (b) field control.
4. To determine polarity and voltage ratio of single phase and three phase transformers.
5. To obtain efficiency and voltage regulation by performing O.C. and S.C. tests on a single phase transformer at full load and 0.8 p.f. loading.
6. To obtain 3-phase to 2-phase conversion using Scott connection.
7. To perform load test on a 3-phase induction motor and determine
(i) Speed- torque characteristics
(ii) Power factor v/s line current characteristics.
8. To study speed control of a 3-phase induction motor using
(a) Voltage Control
(b) Constant (Voltage/ frequency) control.
9. To perform open circuit and short circuit test on a 3-phase synchronous machine and determine voltage regulation at full load and UNITy, 0.8 lagging and 0.8 leading power factor using synchronous impedance method.
10. To determine V-curve of a 3-phase synchronous motor at no load, half load and full load.

Experiments: Minimum five experiments out of following;

B. Automatic Control System:

1. To determine transient response of a second order system for step input for various values of constant 'K' using linear simulator UNIT and compare theoretical and practical results.
2. To study P, PI and PID temperature controller for an oven and compare their performance.
3. To determine speed – torque characteristics of an a.c. 2-phase servo motor.
4. To study and calibrate temperature using Resistance Temperature Detector(RTD)
5. To study dc servo position control system within P and PI configurations.
6. To study synchro transmitter and receiver system and determine output V/s input characteristics.

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Name of Program	Bachelor of Technology (Mechanical Engineering)				
BME4057	Computer Aided Drafting & Modeling Lab	L	T	P	C
Owning School/Department	Mechanical Engineering	0	0	2	2
Pre-requisites/Exposure	-				

Laboratory

UNIT 1:

Drawing Standards - Introduction to CAD software, CAD user interface – Data input modes - Coordinate systems, UNITs and precision – Setting Limits and display UNITs, drawing templates - Features of GUI, Sketching basic geometric entities.

UNIT 2:

Sketching simple geometric Entities-Points, lines, circles, arcs, ellipse, rectangle, polygons, polylines, splines, Use of object snaps - Practice exercises using simple geometric entities

UNIT 3:

Modifying drawings: Move, copy, rotate and offset drawings; Mirroring, Scaling, Trim, extend, erase, explode – Fillet and chamfering – Rectangular, Polar and Path array –
Drawing exercise: Sketching and modifying 2D drawings.

UNIT 4:

Drawing properties: Line type, Line weight, Object properties – Hatch and gradient –Working with Layers – Dimensioning and annotations – Adding tolerance to dimensions – Working with text and tables – Sketching with blocks and groups – Use of attributes – Working with external references – Layout, printing and publishing drawings – Exercise involving sketching 2D orthographic views of 3D geometries with dimensions and tolerances.Introduction to 3D - Isometric drafting – Conversion of orthographic projections of simple components into isometric views

UNIT 5:

Project: Students have to complete a project involving creating orthographic views of the simple machine elements / assemblies such as centrifugal pumps, hydraulic cylinders, gear boxes etc. with dimensions following standard drawing practices using CAD software.

Text Books-

1. James D Bethune, "Engineering Graphics with AutoCAD 2017", Pearson Education, 2018.
2. Gopalakrishna, R., and Sudheer Gopalakrishna "Computer Aided Engineering Drawing", Subhas Publications, 2015.
3. manual (In-House)

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BCN4007	Environmental Sciences	L	T	P	C
Owning School/Department	Mechanical Engineering	0	0	0	0
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Demonstrate analytical thinking skills concerning environmental topics.
CO2: Demonstrate an ability to combine the many disciplines and fields that intersect with environmentalconcerns.
CO3: Illustrate an integrative approach to environmental issues with a focus on sustainability.

Course Contents:

UNIT I: **06 lecture hours**

Environmental Sustainability, Ecosystems, and Climate Change: Overview of Environmental Sustainability, Sustainability and Population Growth, Exploration of Growth Curves, Way forward – Ecosystems and climate change introduction – Ecosystem dynamics –Tragedy of commons - Tragedy of commons solutions – Ecosystems and extinctions – Weather vs. Climate – Climate changes in the past – Climate change in the present – Climate processes.

UNIT II: **05 lecture hours**

Biodiversity and its conservation: Biodiversity – Value of biodiversity – Threats to biodiversity - Conservation of biodiversity – Case studies.

UNIT III: **08 lectures hours**

Natural resources: Natural Resources and Their Challenges, Renewable and Non-renewable Energy Sources, Water's Role in Agriculture, Agriculture's Connection to Food Production, Addressing Issues and Solutions in Agriculture and Food Production.

UNIT IV: **08 lectures hours**

Environmentalpollution: Causes, effects and control measures of various types of pollutions - Air pollution - Water pollution -Wastewater treatment - Soil pollution - Noise pollution - Thermal pollution - - Solid waste management - E-waste-Casestudiesonpollution.

UNIT V: **07 lectures hours**

Ethical Perspectives on the Environment, Global Environmental Policies, Environmental Legislation in India, Environmental Impact Assessment, Challenges Encountered in Enforcing Environmental Laws.

UNIT 6: **08 lectures hours**

Life cycle analysis and sustainability thinking: Introduction of LCA – Methodology of LCA – ISO 14044SignificanceofLCA–CasestudiesofLCA.

Text Books:

1. *Bharucha, Erach. Textbook of environmental studies for undergraduate courses. 2nd ed. Universities Press, 2013.ISBN978-8173718625.*

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Semester-V

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BME5001/ BME5051	Heat Transfer/ Heat Transfer Lab	L	T	P	C
Owning School/Department	Mechanical Engineering	3	1	2	5
Pre-requisites/Exposure					

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: calculate Mechanism of heat transfer, identify basic mechanism of Heat and construct its applications.
CO2: develop the Relation of Extended Surface and calculate mathematical equations.
CO3: identify the methodology of Forced and Natural Convection and able to develop the relations.
CO4: identify radiation and its properties and able to develop the relations
CO5: calculate overall heat transfer coefficient in Heat exchangers

Course Contents:

UNIT I: Introduction to Heat Transfer

Concepts of the mechanisms of heat flows; Conduction, convection and radiation; Effect of temperature on thermal conductivity of materials; Introduction to combined heat transfer mechanism, *Conduction:* One-dimensional general differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems; Initial and boundary conditions. *Steady State One-dimensional Heat conduction:* Composite Systems in rectangular, cylindrical and spherical coordinates with and without energy generation; Thermal resistance concept; Analogy between heat and electricity flow; Thermal contact resistance; Critical thickness of insulation.

UNIT II: Numerical methods in heat conduction

Finite difference formulation of differential equation, One-dimensional steady-state heat conduction, Solution methods for systems of algebraic equations, Two-dimensional heat conduction, Transient heat conduction, *Fins:* Heat transfer from extended surfaces, Fins of uniform cross-sectional area; Errors of measurement of temperature in thermometer wells, *Transient Conduction:* Transient heat conduction; Lumped capacitance method; Time constant; unsteady state heat conduction in one dimension only, Heisler charts.

UNIT III: Convection

Basic concepts; Hydrodynamic boundary layer; Thermal boundary layer; Approximate integral boundary layer analysis; Analogy between momentum and heat transfer in turbulent flow over a flat surface; Mixed boundary layer; Flow over a flat plate; Flow across a single cylinder and a sphere; Flow inside ducts; Empirical heat transfer relations; Relation between fluid friction and heat transfer; Liquid metal heat transfer, *Natural Convection:* Physical mechanism of natural convection; Buoyant force; Empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates and cylinders, and sphere; Combined free and forced convection.

UNIT IV: Thermal Radiation

Basic radiation concepts; Radiation properties of surfaces; Black body radiation Planck's law, Wein's displacement law, Stefan Boltzmann law, Kirchhoff's law; Gray body; Shape factor; Black-body radiation; Radiation exchange between diffuse non-black bodies in an enclosure; Radiation shields; Radiation combined with conduction and convection; Absorption and emission in gaseous medium; Solar radiation; Green-house effect.

UNIT V: Heat Exchanger

Types of heat exchangers; Fouling factors; Overall heat transfer coefficient; Logarithmic mean temperature difference (LMTD) method; Effectiveness-NTU method, Compact heat exchangers, *Condensation and Boiling*: Introduction to condensation phenomena; Heat transfer relations for laminar film condensation on vertical surfaces and on outside & inside of a horizontal tube; Effect of non-condensable gases; Drop wise condensation; Heat pipes; Boiling modes, pool boiling; Hysteresis in boiling curve; Forced convective boiling

Text Books-

1. Heat and Mass Transfer, R.K. Rajput, S. Chand Publishing (5th Ed., 2015).
2. Fundamentals of Heat and Mass Transfer, Frank P. Incropera, David P. DeWitt, Theodore L. Bergman, Adrienne S. Lavine, Wiley (7th Ed., 2011).
3. Heat and Mass Transfer, J.P. Holman, McGraw-Hill Education (10th Ed., 2010).
4. Heat Transfer: Principles and Applications, Binay K. Dutta, PHI Learning (2004, Reprint 2017).
5. Heat and Mass Transfer, P.K. Nag, McGraw-Hill Education (3rd Ed., 2011).

Reference Books-

1. A Textbook of Heat Transfer, S.P. Sukhatme, J.K. Nayak, Universities Press (4th Ed., 2010).
2. Heat Transfer, Adrian Bejan, Wiley (3rd Ed., 2013).
3. Fundamentals of Engineering Heat and Mass Transfer, R.C. Sachdeva, New Age International Publishers (5th Ed., 2017).
4. Convective Heat and Mass Transfer, William Kays, Michael Crawford, Bernhard Weigand, McGraw-Hill (4th Ed., 2005).
5. Fundamentals of Momentum, Heat and Mass Transfer by James R. Welty; John Wiley & Sons (Pvt). Ltd

List of Experiments

Note: Minimum Ten experiment of the following

1. Conduction - Composite wall experiment
2. Conduction - Composite cylinder experiment
3. Convection - Pool Boiling experiment
4. Convection - Experiment on heat transfer from tube-natural convection.
5. Convection - Heat Pipe experiment.
6. Convection - Heat transfer through fin-natural convection.
7. Convection - Heat transfer through tube/fin-forced convection.
8. Any experiment on Stefan's Law, on radiation determination of emissivity, etc.
9. Any experiment on solar collector, etc.
10. Heat exchanger - Parallel flow experiment
11. Heat exchanger - Counter flow experiment

12. Any other suitable experiment on critical insulation thickness.
13. Conduction - Determination of thermal conductivity of fluids.
14. Conduction - Thermal Contact Resistance Effect.

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Professional Elective-I, II, III & IV

(BMEP301-BMEP320)

Professional Elective-I

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Professional Elective-I, II, III & IV

(BMEP351-BMEP354)

Professional Elective-I Lab

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	**Bachelor of Technology (Mechanical Engineering)**				
BME5003/ BME5053	**Non Traditional & Computer Aided Manufacturing/ Non Traditional & Computer Aided Manufacturing Lab**	L	T	P	C
Owning School/Department	**Mechanical Engineering**	3	0	2	4
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Understand the various types of automation manufacturing system.
CO2: Understand Identify various stages of automation like NC, CNC and DNC and their characteristics.
CO3: Discuss NC machine devices and their features.
CO4: Apply NC part programming
CO5: Understand CIMS, GT, FMS & ROBOTS & its types

Course Contents:

UNIT I:
Introduction to manufacturing system, Basic components of NC and its applications, Computer numerical control, direct numerical control, Adaptive control machining systems, Material handling systems, Introduction to robot technology, Robot application

UNIT II:

NC part programming, Manual part programming, Computer assisted part programming, APT language and manual data input, Fundamentals of data communication, Canned cycles and cutter radius compensation

UNIT III:

Turning tool geometry and Tool presetting, Automatic tool changers, Jigs and fixture, Location and its principle, Fixturing for NC machining, Work holding devices, Errors due to location clamping and machining

UNIT IV:

Classifications of material removal processes, Need for non-conventional or non-traditional processes, Characteristics of non-traditional material removal (machining) processes, Chemical and Photo-chemical machining, Electrochemical machining and Electrochemical grinding

UNIT V:

Ultrasonic machining, Abrasive jet machining, Water jet machining, Abrasive water jet machining, Electric discharge machining, Laser beam machining, Electron beam machining-thermal and non-thermal, Plasma machining, Thermal spraying processes-combustion (Detonation gun process) and electrical (plasma spraying), Rapid prototyping

Text Books:

1. Non-Traditional Manufacturing Processes, P.K. Mishra, Narosa Publishing House (7th Reprint, 2012).
2. Non-Conventional Machining, V.K. Jain, McGraw-Hill Education (2017, 2nd Ed.).
3. Advanced Machining Processes, Hassan Abdel-Gawad El-Hofy, McGraw-Hill International (2005).
4. Non-Traditional Machining Processes, Jagadeesha T., I.K. International Publishing House (2010).
5. Modern Machining Processes, Pandey & Shah, Tata McGraw-Hill (Reprint Ed., 2010).

Reference Books:

1. CAD/CAM: Computer Aided Design and Manufacturing, M.P. Groover & E.W. Zimmers, Pearson Education (2015 Reprint).
2. CAD/CAM: Principles and Applications, P.N. Rao, McGraw-Hill Education (3rd Ed., 2010).
3. CAD/CAM/CIM, P. Radhakrishnan, S. Subramanyan, V. Raju, New Age International Publishers (3rd Ed., 2008).
4. Automation, Production Systems, and Computer-Integrated Manufacturing, M.P. Groover, Pearson (4th Ed., 2015).
5. Computer Aided Manufacturing, Tien-Chien Chang, Richard A. Wysk, Hsu-Pin Wang, Pearson Education (2nd Ed., 2005).

List of Experiments:

1. To study the characteristic features of CNC machine
2. Part Programming (in word address format) experiment for turning operation (including operations such as grooving and threading) and running on CNC machine
3. Part Programming (in word address format or ATP) experiment for drilling operation (point to point) and running on CNC machine
4. Part Programming (in word address format or ATP) experiment for milling operation (contouring) and running on CNC machine
5. Experiment on Robot and programs
6. Experiment on Transfer line/Material handling
7. Experiment on difference between ordinary and NC machine, study orretrofitting
8. Experiment on study of system devices such as motors and feed back devices
9. Experiment on Mechatronics and controls

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Open Elective-I, II, III & IV

(BMEO401-BMEO417)

Open Elective-I

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BME5005/ BME5055	Computer Aided Design/ Computer Aided Design Lab	L	T	P	C
Owning School/Department	Mechanical Engineering	3	1	2	5
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: At the end of this course Student will able to discuss the various hardware and software aspect of CAD.

CO2: At the end of this course Student will able to Calculate pixel position using Bresenham Algorithm and coordinate transformation.

CO3: At the end of this course Student will able to Construct curves from given points using various methods.

CO4: At the end of this course student will able to Construct 3D model by utilizing various methods used in 3D graphics.

CO5: At the end of this course student will able to Solve FEM problems.

UNIT-I:

Introduction: Introduction to CAD/CAED/CAE, Elements of CAD, Essential requirements of CAD, Concepts of integrated CAD/CAM, Necessity & its importance, Engineering Applications

Computer Graphics-I

CAD/CAM systems, Graphics Input devices-cursor control Devices, Digitizers, Keyboard terminals, Image scanner, Speech control devices and Touch, panels, Graphics display Devices-Cathode Ray Tube, Random & Raster scan display, and Color CRT monitors, Direct View Storage Tubes, Flat Panel display, Hard copy printers and plotters.

UNIT-II:

Computer Graphics-II Graphics standards, Graphics Software, Software Configuration, Graphics Functions, Output primitives- Bresenham's line drawing algorithm and Bresenham's circle generating algorithm Geometric Transformations: World/device Coordinate Representation, Windowing and clipping, 2D Geometric Transformations-Translation, Scaling, Shearing, Rotation & Reflection Matrix representation, Composite transformation, 3 D transformations, multiple transformation.

UNIT-III:

Curves: Curves representation, Properties of curve design and representation, Interpolation vs approximation, Parametric representation of analytic curves, Parametric continuity conditions, Parametric representation of synthetic curves-Hermite cubic Splines-Blending function formulation and its properties, Bezier Curves-Blending function formulation and its properties, Composite Bezier curves, B-spline curves and its properties, Periodic and non periodic B-spline curves.

UNIT-IV:

3D Graphics: Polygon Surfaces-Polygon mesh representations, Quadric and Super quadric surfaces and blobby objects; Solid Modeling-Solid entities, Fundamentals of Solid Modeling-Set theory, regularized set operations; Half spaces, Boundary representation, Constructive solid geometry, Sweep representation, Color models, Application commands for AutoCAD & Pro-E software

UNIT-V:

Numerical Methods: Introduction, Errors in numbers, Binary representation of numbers, Root Finding-Bisection method, Newton Raphson method, Curve Fitting-Least square method, Numerical Differentiation-Newton's interpolation, Numerical Integration Trapezoidal and Simpson method
Finite Element Method: Introduction, Principles of Finite elements modeling, Stiffness matrix/displacement matrix, Stiffness matrix for spring system, bar & beam elements, bar elements in 2Dspace (truss element)

TEXT BOOKS & REFERENCES:

Text Books

1. CAD/CAM: Computer Aided Design and Manufacturing, M.P. Groover & E.W. Zimmers, Pearson Education (2015 Reprint).
2. CAD/CAM: Principles and Applications, P.N. Rao, McGraw-Hill Education (3rd Ed., 2010).
3. Mathematical Elements for Computer Graphics, David F. Rogers, J. Alan Adams, McGraw-Hill Education (2nd Ed., 1990).
4. Computer Graphics, Donald Hearn, M. Pauline Baker, Pearson Education (2nd Ed., 1997).
5. Principles of Computer-Aided Design and Manufacturing, Farid Amirouche, Pearson Education (1st Ed., 2004).

Reference Books:

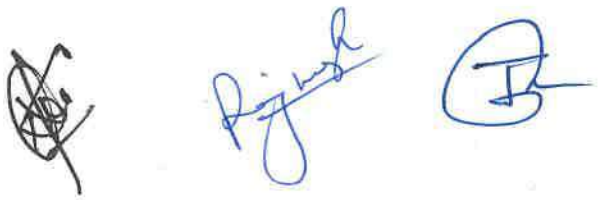
1. Engineering Graphics with AutoCAD, James D. Bethune, Pearson Education (8th Ed., 2016).
2. Mastering CAD/CAM, Ibrahim Zeid, McGraw-Hill Education (2004).
3. Geometric Modeling, Michael E. Mortenson, Industrial Press (3rd Ed., 2006).
4. Mathematical Elements of Computer Aided Design, Roger A. Barnhill, Richard F. Riesenfeld (Editors), Elsevier (2014 Reprint of classic).
5. CAD/CAM, HP Groover& EW Zimmers, Jr. Prentice Hall India Ltd

List of Experiments

Note: Total ten Experiments are too carried out. Five Experiments each from CAD and CAM. A. CAD Experiments

1. Line Drawing or Circle Drawing experiment: Writing and validation of computer program.
2. Geometric Transformation algorithm experiment for translation/rotation/scaling: Writing and validation of computer program.

3. Design of machine component or other system experiment: Writing and validation of computer program.
4. Understanding and use of any 3-D Modeling Software commands.
5. Pro/E/Idea etc. Experiment: Solid modeling of a machine component
6. Writing a small program for FEM for 2 spring system and validation of program or using a fem Package
7. Root findings or curve fitting experiment: Writing and validation of computer program.
8. Numerical differentiation or numerical integration experiment: Writing and validation of computer program.
8. Write a C program for Bezier curve.
9. Write a C program for 3×3 matix multiplication.
10. Write a C program for Hermite Curve.



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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BME5007	Essence of Indian Knowledge Tradition	L	T	P	C
Owning School/Department	Mechanical Engineering	0	0	0	0
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Understand the foundational concepts, sources, and transmission methods of Indian Knowledge Systems.

CO2: Analyze the contributions of Indian traditions in fields such as science, philosophy, health, governance, and education.

CO3: Evaluate the relevance and application of Indian knowledge traditions in contemporary society and interdisciplinary contexts.

Course Contents:

UNIT1:

Understanding Indian Knowledge Systems, Modes of Knowledge Transmission in Ancient India, Vedic Corpus: Foundations of Indian Wisdom, Exploring Vedangas and Upavedas, Classical Indian Philosophical Traditions: An Overview

UNIT II:

Logic and Epistemology in Indian Philosophy, Indian Contributions to Mathematics: From Ancient to Medieval, Advancements in Astronomy and Cosmology in India, Ayurveda: Science of Life and Well-being, Traditional Indian Architecture and Town Planning

UNIT III:

Language and Knowledge: Role of Sanskrit, Indian Literature and Poetics: Exploring Aesthetics and Meaning, Indigenous Knowledge Systems, Indigenous Knowledge in Environment and Ecology: Practices and Wisdom

UNIT IV:

Art, Music, and Dance in Indian Tradition, Governance and Administration in Ancient India, Ethical and Epistemological Concerns in IKS, Relevance and Future of Indian Knowledge Systems, Constitution of India

UNIT V:

Constitutionalism and Indian Context, Making of Indian Constitution: Constituent Assembly and Philosophical Foundations, Preamble: Ideals and Objectives of Constitution, Fundamental Rights: Right to Equality, Fundamental Rights: Freedoms and Other Rights

UNIT VI:

Fundamental Rights: Cultural and Educational Rights and Constitutional Remedies, Directive Principles of State Policy: Guiding Principles for Governance, Fundamental Duties and Responsibilities of Citizens, Union Executive: President and Vice-President

UNIT VII:

Union Executive: Prime Minister and Council of Ministers, Union Legislature: Parliament - Lok Sabha and Rajya Sabha, Judiciary: Supreme Court of India, Federalism and Center-State Relations in IndiaState Government: Executive and Legislature

UNIT VIII:

State Government: Judiciary and Local Self-Government, Constitutional Amendments and Structure Doctrine, Emergency Provisions and Constitutional Governance, Contemporary Debates and Future of Indian Constitution

Text Books:

1. B. Madhavan, Vinayak Rajat Bhat, Nagendra Pavana R.N. "Introduction to Indian knowledge system", PHI Learning Private Limited,2024.
2. Bhatt, S. R., and Anu Mehrotra. "Philosophy of Education: Indian Perspective", D. K. Print world, 2018.

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Semester-VI

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Professional Elective-I, II, III & IV

(BMEP301-BMEP320)

Professional Elective-II

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Open Elective-I, II, III & IV

(BMEO401-BMEO417)

Open Elective-II

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Open Elective-I, II, III & IV

(BMEO401-BMEO417)

Open Elective-II

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BME6001	Industrial Engineering	L	T	P	C
Owning School/Department	Mechanical Engineering	3	1	0	4
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Understand the concept of production system, productivity, facility and process planning in various industries.
CO2: Apply the various forecasting and project management techniques.
CO3: Apply the concept of break-even analysis, inventory control and resource utilization using queuing theory.
CO4: Apply principles of work study and ergonomics for design of work systems
CO5: Understand the basics of Total Quality Mangament and control theory

Course Contents:

UNIT I: Overview of industrial engineering
Types of production systems, Concept of productivity, Principle of plant layout design, Types of plant layout, Computer aided layout design techniques, Materials handling principles, Types of material handling systems, Methods of process planning, Flexible Manufacturing

UNIT II: Production Planning and control

Aggregate production planning, Materials requirement planning (MRP) and MRP-II, Routing, scheduling and priority dispatching, Concept of JIT manufacturing system, Project network analysis, CPM, PERT and Project crashing

UNIT III: Engineering economies and Inventory control

Break-even analysis, Techniques for evaluation of capital investments, Inventory functions, ABC analysis, VED analysis

UNIT IV: Product Design and Development

Principles of product design, quality and cost considerations, product life cycle, value engineering and analysis, concurrent engineering

UNIT V: Introductions to Total Quality Management

Principles of TQM, Seven tools of Quality control, Techniques of TQM, ISO standards, Benchmarking, Six Sigma basic

Text Books:

1. Industrial Engineering and Production Management by Martand T Telsang S. Chand Publishing
2. Industrial Engineering and Production Management by M. MahajanDhanpatRai& Co. (P) Limited
3. Industrial Engineering and Management by Ravi Shankar, Galgotia Publications Pvt Ltd
4. Production and Operations Management by Adam, B.E. & Ebert, R.J., PHI

5. Product Design and Manufacturing by Chitale A.V. and Gupta R.C., PHI

Reference Books:

1. Operations Research Theory & Applications by J K Sharma, Macmillan India Ltd,
2. Production Systems Analysis and Control by J. L. Riggs, John Wiley & Sons
3. Automation, Production Systems & Computer Integrated Manufacturing by Groover, M.P. PHI
4. Operations Research, by A.M. Natarajan, P. Balasubramani, A. Tamilarasi, Pearson Education
5. Operations Research by P. K. Gupta and D. S. Hira, S. Chand & Co.

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BME6002/BME6053	Operation Research	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	4	5
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Define and formulate linear programming problems and appreciate their limitations.
CO2: Solve linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained and translate solutions into directives for action.
CO3: Conduct and interpret post-optimal and sensitivity analysis and explain the primal-dual relationship.
CO4: Develop mathematical skills to analyse and solve integer programming and network models arising from a wide range of applications.
CO5: Effectively communicate ideas, explain procedures and interpret results and solutions in written and electronic forms to different audiences

Course Contents:

UNIT I: Introduction

Definition and scope of operations research (OR), OR model, Solving the OR model, art of modeling, phases of OR study, Linear Programming: Two variable Linear Programming model, Graphical method of solution, Simplex method, Dual Simplex method, Special cases of Linear Programming, duality, sensitivity analysis

UNIT II: Transportation Problems

Types of transportation problems, Mathematical models, transportation algorithm, Assignment: Allocation and assignment problems and models, Processing of job through machines

UNIT III: Network Techniques

Shortest path model, Project Management: Phases of project management, Guidelines for network construction, CPM and PERT

UNIT IV: Theory of Games

Minima theorem, Graphical solution of 2 x n or m x 2 games, Reduction to linear programming model, Quality Systems: Elements of Queuing model

UNIT V: Inventory Control

Models of inventory, operation of inventory system, quantity discount, Replacement models: Equipments that deteriorate with time

Text Books:

1. Wayne L. Winston," Operations Research" Thomson Learning,2003.
2. Hamdy H. Taha, "Operations Research-An Introduction" Pearson Education,2003.
3. R. PanneerSeevam, "Operations Research" PHI Learning, 2008.
4. V. K. Khanna, "Total Quality Management" New Age International, 2008

5. Operations Research, D.S. Hira & P.K. Gupta, S. Chand Publishing (2016 Reprint).

Reference Books:

1. Operations Research, Ravindran, Phillips, Solberg, Wiley India (2nd Ed., 2007).
2. Operations Research, J.K. Sharma, Macmillan India (5th Ed., 2013).
3. Operations Research, R. Panneerselvam, PHI Learning (2nd Ed., 2010).
4. Operations Research with Applications, Prem Kumar Gupta, D.S. Hira, S. Chand (2015).
5. Optimization in Operations Research, Ronald L. Rardin, Pearson (1997).

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BME6005	Product Design and Development	L	T	P	C
Owning School/Department	Mechanical Engineering	2	0	0	2
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Plan a product line for the specific target market your team is designing

CO2: Conduct detailed research on target market with documentation and research tools.

CO3: Understand the life cycle of garment production for the mass market

CO4: Present collection to a juried audience.

CO5: Construct team-designed garments while working in a team environment

UNIT-1

Concept of Product, definition and scope, Design definitions, old and new design methods, design by evolution, examples such as evolution of sewing M/C, bicycle, safety razor etc., need based developments, technology based developments physical reliability & economic feasibility of design concepts.

UNIT –II

Morphology of design, divergent, transformation and convergent phases of product design, identification of need, Analysis of need, Design criteria; functional, aesthetics, ergonomics, form, shape, size, color. Mental blocks, Removal blocs, Ideation techniques, Creativity, Check list.

UNIT –III

Transformations, Brainstorming & Synetics, more phological techniques, Utility Concept, Utility Value, Utility Index, Decision making under Multiple Criteria. Economic aspects, Fixed and variable costs, Break-even analysis

UNIT-IV

Reliability considerations, Bath tub curve, Reliability of systems in series and parallel, Failure rate, MTTF and MTBF, Optimum spares from Reliability considerations. Design of display and controls, Man-machine interface, Compatibility of displays and controls, Ergonomic aspects, its importance in design, Application of Computers in Product development & design

UNIT-V

Existing techniques, such as work-study, SQC etc. for improving method & quality of product, Innovation versus Invention, Technological Forecasting, Use of Standards for Design

Text Books-

1. Product Design and Development, Karl T. Ulrich & Steven D. Eppinger, McGraw-Hill Education (6th Ed., 2015).
2. Engineering Design, Gerhard Pahl & Wolfgang Beitz, Springer (3rd Ed., 2007).

3. Product Design and Manufacture, A.K. Chitale & R.C. Gupta, PHI Learning (4th Ed., 2013).
4. Product Design and Development, Anil Mital, A. B. Shetty, Anand Subramanian, A. K. Pandey, Elsevier (2014).
5. The Mechanical Design Process, David G. Ullman, McGraw-Hill Education (5th Ed., 2010).

Reference Books-

1. C.D. Cain, "Product Design & Decision" Business Books.
2. A.K. Chitab& R.C. Gupta "Product design & Manufacturing" – Prentice Hall (EE)
3. R.P. Crewford, "The Technology of creation Thinking" Prentice Hall.
4. Design and Development of Products, John W. Gosling, CRC Press (2015).
5. Product Design and Manufacturing, Sadhu Singh, Khanna Publishers (2012).

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	**Bachelor of Technology (Mechanical Engineering).**				
BME6054	**Mini Project**	L	T	P	C
Owning School/Department	**Mechanical Engineering**	0	0	2	1
Pre-requisites/Exposure	-				

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

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Name of Program	Bachelor of Technology (Mechanical Engineering)				
BME6055	Numerical and Statistical Methods Lab	L	T	P	C
Owning School/Department	Mechanical Engineering	0	0	2	1
Pre-requisites/Exposure	-				

List of Experiments

1. Introduction to MATLAB
   - Basics of programming using MATLAB
   - Array operations in MATLAB
   - Loops & Execution control: Relational & Logical Operators, If-Else conditional statement, For-end
2. Loop (Fibonacci series using For loop), While-end Loop (Fibonacci series using While loop)
   - Introduction to script and function file
3. Errors and Approximations
   - Errors in Numerical Computations
   - Truncation Error and Taylor's series
   - Round off Errors and Iterative Method
   - Step-wise methods and Error propagation
4. System of Linear Equations
   - Basics of linear algebra
   - Gauss elimination & back substitution
   - Gauss seidel method
5. Program for finding the roots of an equation
   - Bisection Method
   - Secant Method
   - Regula-Falsi Method
   - Newton Raphson Method
6. Numerical Integration
   - Trapezoidal Rule
   - Simpson 1/3 Rule
   - Simpson 3/8 Rule
7. Curve Fitting
   - Introduction to curve fitting
   - Least square regression

References:

1. Applied Numerical Methods with Matlab by Steven C. Chapra, McGraw Hill Education (India) Private Limited
2. Applied Numerical Analysis Using Matlab by Fausett L.V, Pearson Education India
3. Matlab: An Introduction with Applications by AMOS GILAT, WILEY

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

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Name of Program	**Bachelor of Technology (Mechanical Engineering)**				
BME6006	**Summer Internship/Field Work (Minimum 8 Weeks)**	**L**	**T**	**P**	**C**
Owning School/Department	**Mechanical Engineering**	0	0	0	1
Pre-requisites/Exposure	-				

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

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Semester-VII

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Professional Elective-I, II, III & IV

(BMEP301-BMEP320)

Professional Elective-III

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Open Elective-I, II, III & IV

(BMEO401-BMEO417)

Open Elective-III

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BME7001	Dynamic System Vibration and Control	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Analyze the causes and effects of vibrations in mechanical systems and identify discrete and continuous systems

CO2: Model the physical systems into schematic models and formulate the governing equations of motion.

CO3: Compute the free and forced vibration responses of multi degree of freedom systems through modal analysis and interpret the results

CO4: Analyze and design systems involving unbalances, transmissibility, vibration isolation and absorption.

CO5: Analyze and design to control and reduce vibration effects in machinery.

UNIT -I

Introduction: Causes and effects of vibration, Classification of vibrating system, Discrete and continuous systems, degrees of freedom, Identification of variables and Parameters, Linear and nonlinear systems, linearization of nonlinear systems, Physical models, Schematic models and Mathematical models.

UNIT-II

Single Degree of Freedom (SDF) systems: Formulation of equation of motion: Newton – Euler method, De Alembert's method, Energy method, Free Vibration: Undamped Free vibration response, Damped Free vibration response, Case studies on formulation and response calculation. Forced vibration response of SDF systems: Response to harmonic excitations, solution of differential equation of motion, Vector approach, Complex frequency response, Magnification factor Resonance, Rotating/reciprocating unbalances. Dynamics of Rotors: Whirling of rotors, Computation of critical speeds, influence of bearings, Critical speeds of Multi rotor systems.

UNIT-III

Two degree of freedom systems: Introduction, Formulation of equation of motion: Equilibrium method, Lagrangian method, Case studies on formulation of equations of motion, Free vibration response, Multi degree of freedom systems: Introduction, Formulation of equations of motion, Free vibration response, Natural modes and mode shapes, Modal damping, Rayleigh's damping, Introduction to experimental modal analysis.

UNIT-IV

Continuous systems: Introduction to continuous systems, discrete vs. continuous systems, Exact and approximate solutions, free vibrations of bars and shafts, Free vibrations of beams,

Forced vibrations of continuous systems Case studies, Approximate methods for continuous systems and introduction to Finite element method.

UNIT-V

Vibration control in structures: Introduction, State space representation of equations of motion. Passive control, active control and semi active control, Free layer and constrained damping layers, Piezo electric sensors and actuators for active control, semi active control of automotive suspension systems.

Text Books:

1. Mechanical Vibrations, S.S. Rao, Pearson Education (6th Ed., 2017).
2. Mechanical Vibrations, J.P. Den Hartog, Dover Publications (Reprint, 1985).
3. Theory of Vibrations with Applications, William T. Thomson & Marie Dillon Dahleh, Pearson (5th Ed., 2018).
4. Fundamentals of Vibrations, Leonard Meirovitch, McGraw-Hill (2001).
5. Mechanical Vibrations, Singiresu S. Rao. Pearson (2017).

Reference Books:

1. Singiresu S Rao, Mechanical Vibrations. 4th Ed., Pearson education, 2011
2. Clarence W. De Silva, Vibration: Fundamentals and Practice, CRC Press LLC,2000
3. Venkatachalam R., Mechanical Vibrations, PHI Publications, 201
4. L. Meirovich, Elements of Vibration Analysis, 2nd Ed. Tata Mc-Grawhill, 2007
5. Mechanical Vibrations By VP Singh, Dhanpat Rai, 2012

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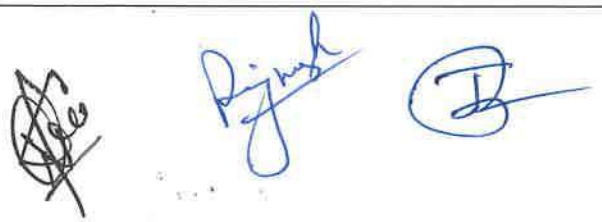
Name of Program	Bachelor of Technology (Mechanical Engineering)				
BME7052	Capstone Project Phase I	L	T	P	C
Owning School/Department	Mechanical Engineering	0	0	12	6
Pre-requisites/Exposure	-				



Or

Open Elective-I, II, III & IV

(BMEO401-BMEO417)

Open Elective-III

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	**Bachelor of Technology (Mechanical Engineering)**				
BME7052	**Industry Project/R&D Project/ Industry Internship/ Start-Up/ Externship**	L	T	P	C
Owning School/Department	**Mechanical Engineering**	0	0	24	12
Pre-requisites/Exposure	-				

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Semester-VIII

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Professional Elective-I, II, III & IV

(BMEP301-BMEP320)

Professional Elective-IV

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

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Open Elective-I, II, III & IV

(BMEO401-BMEO417)

Open Elective-IV

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	**Bachelor of Technology (Mechanical Engineering)**				
BME8051	**Capstone Project Phase II**	**L**	**T**	**P**	**C**
Owning School/Department	**Mechanical Engineering**	0	0	18	9
Pre-requisites/Exposure	-				

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Professional Elective

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	**Bachelor of Technology (Mechanical Engineering)**				
BMEP301/ BMEP351	**Introduction to Automobile Engineering/ Introduction to Automobile Engineering Lab**	L	T	P	C
Owning School/Department	**Mechanical Engineering**	3	0	2	4
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: At the end of this course Student will able to Define Basic concepts of Automobile Engineering, Illustrate, Different types of force and resistance acting on it

CO2: At the end of this course Student will able to understand the basics of power transmission system, Classify Different types of steering geometry.

CO3: At the end of this course Student will able to Compare Between different types of breaking system, understand the basic terminologies of different system.

CO4: At the end of this course student will able to Recall Different Electrical and fuel supply system

CO5: At the end of this course Student will able to Understand Several types of pollution norms made by government, Classify the different types of maintenance.

Course Contents:

UNIT I:

Automotive Engine: Fundamental of engine operation, Engine construction, Engine types & classification, Difference between SI and CI engine, Difference between two stroke and four stroke engines, Hardware changes related to SI and CI engines (Injection and Ignition system), Overview of engine lubrication and cooling system, Automotive engine fuel, Valve diagram, Engine measurement & performance, Turbochargers, Exhaust gas recirculation system

UNIT II:

Automotive Electrical & Electronics: Manual ignition systems, Electronic capacitance discharge ignition system, Electronic transistorized ignition system, Electronic piezo-electric ignition system, Distributor less ignition systems, Sensors and actuators: Basic sensor arrangement, Types of sensors: Oxygen sensors, Crank angle position sensors, Fuel metering/vehicle speed sensor and detonation sensor, Throttle position sensors

UNIT III:

Automotive Chassis: General consideration relating to chassis layout, Classification based on engine location, Type of automobile designs, Type of frame, Materials of chassis, Commercial vehicle chassis frame

UNIT IV:

Automotive Suspension & Steering Systems: Dependent and independent suspension systems, Factors influencing ride comfort, Shock absorbers, Steering geometry: Ackermann and Davis steering, Electronic power steering, Four-wheel steering, Wheel alignment

UNIT V:

Drive Trains: Drive shafts, Universal joints, Differential gear box, Drive axle, Automatic transmission system, Transaxle, Manual transaxle, Single plate clutch, Multi plate clutch, Constant mesh and synchromesh gear box, Automotive Brakes & Tires: Type of brakes, Principles of shoe brakes, Constructional details: disc brake, Drum brake theory, Manual brakes, Antilock braking systems, Tyre: Types of tyre and constructional details, Traction control, Types of wheels

Text Books:

1. Automotive Mechanics by William H. Crouse and Donald L. Anglin, Mcgraw Hill
2. Education (India) Private Limited
3. Automobile Engineering, Kirpal Singh (Vol. I, II, III), Standard Publishers, Delhi (Latest Reprint 2011).
4. Automobile Engineering, R.K. Rajput, Laxmi Publications (2012).
5. A Textbook of Automobile Engineering, R.S. Khurmi & J.K. Gupta, S. Chand Publishing (2010).

Reference Books:

1. Automotive Mechanics by S Srinivasan, Mc Graw Hill Education
2. Automobile Engineering, Dr. Kirpal Singh (Vol. I: Power Plant, Vol. II: Systems, Vol. III: Maintenance), Standard Publishers.
3. Automobile Engineering by R. B. Gupta, Tech India Publications
4. Automotive Mechanics, William H. Crouse & Donald L. Anglin, McGraw-Hill Education (10th Ed., 2012).
5. Automobile Engineering, Dr. N.K. Giri, Khanna Publishers (2002).

List of Experiment:

1. Performance Analysis of Four strokes S.I. Engine- Determination of indicated and brake thermal efficiency, specific fuel consumption at different loads, Energy Balance.
2. Determination of Indicated H.P. of I.C. Engine by Morse Test.
3. Performance Analysis of Four stroke C.I. Engine- Determination of indicated and brake thermal efficiency, specific fuel consumption at different loads, Energy Balance
4. Study & experiment on Valve mechanism.
5. Study & experiment on Gear Box.
6. Study & experiment on Differential Gear Mechanism of Rear Axle.
7. Study & experiment on Steering Mechanism.
8. Study & experiment on Automobile Braking System.
9. Study & experiment on Chassis and Suspension System.
10. Study & experiment on Ignition system of I.C. Engine.
11. Study & experiment on Fuel Supply System of S.I. Engines- Carburetor, Fuel Injection Pump and MPFI.
12. Study & experiment on Fuel Supply System of C.I. Engines- Injector & Fuel Pump.
13. Study & experiment on Air Conditioning System of an Automobile.
14. Comparative study of technical specifications of common small cars (such as Maruti Swift, Hyundai i20, Chevrolet Aveo, Tata Indica, Ford Fusion etc.

15. Comparative study & technical features of common scooters & motorcycles available in India.
16. Experiment on Engine Tuning.
17. Experiment on Exhaust Gas Analysis of an I.C. Engine.

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	**Bachelor of Technology (Mechanical Engineering)**				
BMEP302/ BMEP352	**Refrigeration & Air Conditioning/ Refrigeration & Air Conditioning Lab**	**L**	**T**	**P**	**C**
Owning School/Department	**Mechanical Engineering**	3	0	2	4
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Student will be able to learn about basics of refrigeration and air conditioning.
CO2: Student will able to learn about mathematical analysis of COP of various refrigeration systems
CO3: Discuss the working knowledge of different types of cooling systems
CO4: About human comfort and basics of air- conditioning
CO5: About psychometric of air conditioning processes

Course Contents:

UNIT I:

Refrigeration: Introduction to refrigeration system, Methods of refrigeration, Carnot refrigeration cycle, UNIT of refrigeration, Refrigeration effect & C.O.P.
Air Refrigeration cycle: Open and closed air refrigeration cycles, Reversed Carnot cycle, Bell Coleman or Reversed Joule air refrigeration cycle, Aircraft refrigeration system, Classification of aircraft refrigeration system. Boot strap refrigeration, Regenerative, reduced ambient, Dry air rated temperature (DART).

UNIT II:

Vapour Compression System: Single stage system, Analysis of vapour compression cycle, Use of T-S and P-H charts, Effect of change in suction and discharge pressures on C.O.P, Effect of sub cooling of condensate &superheating of refrigerant vapour on C.O.P of the cycle, Actual vapour compression refrigeration cycle, Multistage vapour compression system requirement, Removal of flash gas, Intercooling, Different configuration of multistage system, Cascade system, Cryogenics refrigeration.

UNIT III

Vapour Absorption system; Working Principal of vapour absorption refrigeration system, Comparison between absorption & compression systems, Elementary idea of refrigerant absorbent mixtures, Adiabatic mixing of two streams, Ammonia – Water vapour absorption system, Lithium-Bromide water vapour absorption system, Comparison.
Refrigerants: Classification of refrigerants, Nomenclature, Desirable properties of refrigerants, Common refrigerants, Secondary refrigerants and CFC free refrigerants.

UNIT IV

Air Conditioning: Introduction to air conditioning, Psychometric properties and their definitions, Psychometric chart, Different Psychometric processes, Thermal analysis of human body, Effective temperature and comfort chart, Cooling and heating load calculations, Selection of inside & outside design conditions, Heat transfer through walls & roofs, Infiltration &

ventilation, Internal heat gain, Sensible heat factor (SHF), By pass factor, Grand Sensible heat factor (GSHF), Apparatus dew point (ADP).

UNIT V

Refrigeration Equipment & Application: Elementary knowledge of refrigeration & air conditioning equipment's e.g. compressors, condensers, evaporators & expansion devices, Air washers, cooling towers & humidifying efficiency, Food preservation, Cold storage, Refrigerates Freezers, Ice plant, Water coolers, Elementary knowledge of transmission and distribution of air through ducts and fans, Basic difference between comfort and industrial air conditioning.

Text Books:

1. Refrigeration and Air Conditioning, C.P. Arora, McGraw-Hill Education (3rd Ed., 2010).
2. Refrigeration and Air Conditioning, R.S. Khurmi & J.K. Gupta, S. Chand Publishing (2011).
3. Refrigeration and Air Conditioning, P.L. Ballaney, Khanna Publishers (2014).
4. Principles of Refrigeration, Roy J. Dossat & Thomas J. Horan, Pearson (5th Ed., 2002).
5. Refrigeration and Air Conditioning, Domkundwar & Arora, Dhanpat Rai & Co. (2010).

Reference Books:

1. Refrigeration and Air Conditioning, Ananthanarayanan, McGraw-Hill Education (2013).
2. Refrigeration and Air Conditioning, W.F. Stoecker & J.W. Jones, McGraw-Hill Education (2nd Ed., 1982).
3. Refrigeration and Air Conditioning Technology, Bill Whitman, Bill Johnson, John Tomczyk, Eugene Silberstein, Cengage Learning (8th Ed., 2016).
4. Refrigeration and Air Conditioning, Manohar Prasad, New Age International (2003).
5. Refrigeration and Air Conditioning, Arora & Domkundwar, Dhanpat Rai & Sons (2010).

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEP303/ BMEP353	Computer Aided Manufacturing/ Computer Aided Manufacturing Lab	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	2	4
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Obtain knowledge on NC Machine.
CO2: Program CNC part Programming.
CO3: Design and implementation of part programming
CO4: Understand the concepts of Computer Aided Process Planning
CO5: Implement Artificial Intelligence in Manufacturing

Course Contents:

UNIT-I
Introduction: Introduction to Automation, Need and future of NC Systems and CAM, Advantages and Disadvantages, Open and Closed loop systems, Historical developments and future trends. Future of NC Machines, Difference between ordinary and NC Machine tools, Methods for improving accuracy and productivity.

UNIT-II
Control of NC Systems: Types of CNC Machine Tools systems devices, e.g. encoders and interpolators, Features of CNC Systems, Direct Numerical Control (DNC), Standard Controllers and General Programming features available in CNC Systems, Computer Process monitoring and Control. Adaptive control systems

UNIT III
NC Part Programming: Manual Programming for simple parts, e.g., turning, milling, drilling, etc. Computer aided NC Programming in APT language, use of canned cycles, Generation of NC Programmes through CAD/CAM systems, Design and implementation of post processors.

UNIT-IV
Computer Aided Process Planning: Introduction, Manual process planning vs. Computer aided process planning, Basics of variant and generative process plan methods, Examples of automated process planning systems.

UNIT-V
Artificial Intelligence in Manufacturing: Introduction, Elements of Expert Systems, Introduction to Neural Networks, Expert Systems application in manufacturing, Case studies

Text Books:

1. Computer-Aided Manufacturing, Tien-Chien Chang, Richard A. Wysk, Hsu-Pin Wang, Pearson Education (2nd Ed., 2005).
2. Computer-Aided Manufacturing, Rao P.N., McGraw-Hill Education (4th Ed., 2010).
3. CAD/CAM, P.N. Rao, McGraw-Hill Education (2017).
4. Automation, Production Systems, and Computer-Integrated Manufacturing, Mikell P. Groover, Pearson Education (4th Ed., 2015).
5. Computer Numerical Control, Warren S. Seames, Cengage Learning (2002).

Reference Books:

1. CAD/CAM Groovers Prentice Hall.
2. NC Machine Tools S.J. Martin.
3. CAD/CAM P.N. Rao.
4. CAD/CAM P Radhakrishnan, S Subramanyam, V.
5. Computer Aided Manufacturing Chang, Wysk, Wang.

CAM Experiments

1. To study the characteristic features of CNC machine
2. Part Programming (in word address format) experiment for turning operation (including operations such as grooving and threading) and running on CNC machine
3. Part Programming (in word address format or ATP) experiment for drilling operation (point to point) and running on CNC machine
4. Part Programming (in word address format or ATP) experiment for milling operation (contouring) and running on CNC machine
5. Experiment on Robot and programs
6. Experiment on Transfer line/Material handling
7. Experiment on difference between ordinary and NC machine, study or retrofitting
8. Experiment on study of system devices such as motors and feedback devices
9. Experiment on Mechatronics and controls

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEP304/ BMEP354	Heat Treatment & Processing/ Heat Treatment & Processing Lab	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	2	4
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Identify the effect of heating & cooling on phase transformation along with its mechanism.

CO2: Establish different heat treatment process, selection of process parameters & factors affecting the mechanical properties.

CO3: Describe along with evaluate & communicate different surface hardening & special heat treatment process.

CO4: Evaluate the effect of heat treatment by understanding different applications

CO5: Develop skill in the student to change hardening & tempering properties of steel

Course Contents:

UNIT I: Principles of Heat Treatment of Steels

Phase Transformation on Heating, Formation of Austenite, Austenitic Grain Size, Grain Growth, Determination and Importance of Grain Size, Method of Plotting, Types of TTT Diagram, Critical Cooling Rate, Effect of Alloying Elements on TTT Diagram

UNIT II: Transformations

Pearlitic Transformation, Mechanism, Effect of Alloying Elements on Transformation, Bainitic Transformation-Mechanism Characteristics, Bainitic Structure, Theory of Martensitic Transformation, Retained Austenite, Martensitic Transformation in Fe-Ni Systems

UNIT III: Heat Treatment Processes

Annealing, Recrystallization Annealing, Full Annealing, Partial Annealing, Bright Annealing, Diffusion Annealing, Spheroidizing, Normalizing and application

UNIT IV: Surface Hardening of Metals

Principals Involved in Induction and Flame Hardening, Method and application of Selective Hardening, Laser Hardening, Case Carburizing (Solid, Liquid and Gaseous), Cyaniding, Carbo nitriding, Nitriding, Plasma Nitriding, Depth of Penetration

UNIT V: Special Heat Treatment Processes

Austempering, Martempering, Ausforming, Sub-Zero Treatment, Thermo-Mechanical Treatments, Heat Treatment of Alloy Steels, Aluminium Alloys, Age Hardening

Text Books:

1. Heat Treatment: Principles and Techniques ByRajan, T. V., Sharma, C. P., Sharma, Ashok, Phi Learning Delhi
2. Heat Treatment, T.V. Rajan, C.P. Sharma, Ashok Sharma, PHI Learning Pvt. Ltd. (2nd Ed., 2011).
3. Heat Treatment. Rajan & Sharma, PHI Learning (2012 Reprint).
4. Principles of Heat Treatment of Steel, George Krauss, ASM International (2nd Ed., 1990).
5. Heat Treatment and Processing Principles, E.L. Kuhn, G. Krauss, R.A. Stickels, ASM International (2001).

References:

1. Steel Heat Treatment, George E. Totten, CRC Press (2006).
2. Heat Treatment of Gears, A.K. Rakhit, ASM International (1999).
3. Practical Heat Treating, J.L. Duliere, ASM International (2nd Ed., 1996).
4. Heat Treatment of Metals, B.L. Mordike, Butterworth-Heinemann (2001).
5. Introduction to Physical Metallurgy by Sidney Avner, Mcgraw Hill Education

List of Experiments

1. Grain Fineness Test
2. Clay Content Test
3. Permeability Test
4. Compression Strength Test for Moulding Sand
5. Shear Strength Test for Moulding Sand
6. Tensile Strength Test for Core Sand
7. Bending Strength Test for Core Sand
8. Green Sand Moulding without Pattern
9. Green Sand Moulding with Pattern

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Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEP305	Automotive Vehicle Design	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Generalize the selection of vehicle specifications on the basis of various forces and resistance.

CO2: Choose a suitable vehicle frames and suspension systems by calculating different type of loads and moment.

CO3: Select the suitable clutch and transmission systems for the given vehicle specifications.

CO4: Calculate the loads and moment on steering, final drive, front and rear axle systems in a vehicle.

CO5: Choose a suitable brake system for the given vehicle specification

Course Contents:

UNIT – I: INTRODUCTION

Study and Selection of Vehicle Specifications - Choice of Cycle, Fuel, Speed, Method of Cooling, Material, Design Variables and Operating Variables Affecting Performance and Emission, Benchmarking. Calculation and Plotting the Curves of Air, Rolling and Gradient Resistances, Driving Force – Engine Power, Speed, Differential Ratio, Rear Axle Ratio, Torque and Mechanical Efficiency at Different Vehicle Speeds, Vehicle Interior and Exterior Design, Ergonomics and Styling.

UNIT – II: DESIGN OF VEHICLE FRAMES, BODY AND SUSPENSION

Design of Frame Members: Longitudinal, Cross and Support Members for Heavy and Light Vehicles, Load, Moment and Stress Calculations, Design of Vehicle Body, Design of Springs, Leaf, Coil and Torsion Bar, Design of Hydraulic, Pneumatic and Rubber Suspension.

UNIT – III: DESIGN OF CLUTCH AND TRANSMISSION

Design of Clutch and its Components, Single Plate, Multi Plate, Cone and Centrifugal Clutch, Energy Dissipated and Torque Capacity Calculations, Design of Roller and Sprag Type Clutches, Surplus Power and Torque, Calculations and Acceleration Curves, Gear Ratio Calculations, Acceleration and Gradability - Typical Problems, Design of Gearbox: Constant Mesh, Sliding, Mesh and Synchromesh, Design of Automatic Transmission

UNIT – IV: DESIGN OF STEERING, AXLES AND FINAL DRIVE

Design of Rear Axle Bearing Loads, Axle and Axle Housing: Semi Floating, Three Quarter, Floating and Full Floating, Design of Loads, Moments and Stresses Across Front Axle, Design of Front Axle Bearing Loads and Axle, Design of Propeller Shaft, Differential and Final Drive, Choice of Lubrication, Bearing and Materials for Rear Axle, Front Axle and Final Drive

UNIT – V: DESIGN OF BRAKES

Introduction, Energy Absorbed by a Brake, Heat to be Dissipated During Braking, Materials for Brake Lining, Types of Brakes, Single Block or Shoe Brake, Pivoted Block or Shoe Brake, Double, Block or Shoe Brake, Internal Expanding Brake.

Text Books

1. R. S. Khurmi J.K. Gupta 'A Textbook of Machine Design' Eurasia Publishing House (Pvt.) Ltd, New Delhi- 2005
2. Automotive Vehicle Safety Design, George Blom, SAE International (2006).
3. The Automotive Body, L.J. Kutzbach, Springer (2011).
4. Fundamentals of Vehicle Dynamics, Thomas D. Gillespie, SAE International (1992).
5. Automotive Engineering, Brian Cantor, Patrick Grant, Colin Johnston, Taylor & Francis (2008).

References

1. Heldt.P.M - "Automotive Chassis"- Chilton Co., New York- 1992.
2. Steeds. W -"Mechanics Of Road Vehicles"- Illiffe Books Ltd., London- 1990
3. Giles. K. G - Steering, Suspension andTires"- Wildlife Books Ltd., London – 1988.
4. Newton Steeds & Garret- "Motor Vehicle"- Wildlife Books Ltd., London – 2001
5. Giri. N. K- "Automobile Mechanics"- Khanna Publisher, New Delhi- 2012.

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Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEP306	Fundamentals of HVAC	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Define basic HVAC terminology and fundamentals.
CO2: Discuss the working knowledge of different types of heating systems.
CO3: Discuss the air-conditioning systems for the different weather conditions
CO4: About human comfort and basics of air- conditioning.
CO5: About psychometric of air conditioning processes

Course Contents:

UNIT I:

Introduction of HVAC systems and radiant heating and radiators, Common HVAC UNITs and dimensions, Fundamental physical concepts: heating, cooling, Humidification and dehumidification, Radiant heating: types of radiant heating, hydraulic radiant floor heating, Radiators and its efficiency, Radiator heat output and sizing of radiators

UNIT II:

Fireplaces, Chimneys and Water Heaters, Fireplace, Modified fireplace, Chimney draft, Constructional details of chimney, Water heater: types of water heaters, Direct-fired water heaters, Automatic storage water heaters, Multi coil water heaters, Multi flue water heaters, Instantaneous water heaters, Indirect water heaters, Quick-recovery heaters, Heat pump water heaters, Combination water heaters

UNIT III:

Ventilation principles: Motive force, Inductive action of the wind, induced draft, Combined force of wind effect and thermal effect, Mechanical ventilation, Roof ventilators and types, Capacity of ventilators, Design and placement of inlet air openings, Ventilator dampers and types, Method of calculating number and size of ventilators required, Air leakage

UNIT IV:

Human Comfort and Basics of Air-conditioning, Energy balance of human body, Brief history of air conditioning, Working substance in air conditioning, Psychometric properties, Wet bulb temperature, Thermodynamic wet bulb temperature, Psychometric chart, Construction of psychometric chart, Application of first law to a psychometric chart

UNIT V:

Psychometric of air conditioning processes, Mixing process, Basic processes in conditioning of air, Psychometric processes in air conditioning equipment, Simple air conditioning system and state and mass rate of supply air, summer air conditioning - apparatus dew point, winter air conditioning

Text Books:

1. HVAC fundamentals (vol. 3: air-conditioning, heat pumps, and distributionSystems) by brumbaugh, j. E., wiley
2. Refrigeration and air-conditioning by arora, c. P., tata mcgraw hill, india
3. Refrigeration and Air Conditioning, C.P. Arora, McGraw Hill India (3rd Ed., 2010).
4. Heating and Cooling of Buildings, Jan F. Kreider, Peter S. Curtiss, Ari Rabl, CRC Press (2nd Ed., 2009).
5. HVAC Fundamentals, Samuel Sugarman, Fairmont Press / CRC (3rd Ed., 2005).

References:

1. Heating, ventilating and air-conditioning: analysis and design by Mcquiston, f. C., parker, j. D., spitler, j. D., wiley
2. Air-conditioning principles and systems – an energy approach by pita, e. G., Pearson
3. Modern Refrigeration and Air Conditioning, Andrew D. Althouse, Carl H. Turnquist, Alfred F. Bracciano, Goodheart-Willcox (19th Ed., 2016).
4. Heating, Ventilation and Air Conditioning, Ameen Al-Azzawi, Springer (2016).
5. Heating, Ventilation, and Air Conditioning, Ali Vedavarz, Sunil Kumar, Muhammed Iqbal Hussain, Industrial Press (2007).

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEP307	Mechatronics	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Discuss the Introduction of systems, definition of mechatronics, applications of mechatronics in design and modelling.
CO2: Calculate Electronics elements in mechatronics and Computing elements in mechatronics
CO3: Construct System modelling and analysis with control system concepts and Motion control devices.
CO4: Construct Sensors and transducers and their static and dynamic performance characteristic
CO5: SolveMechatronics in industry, autotronics, bionics and avionics and their various applications.

Course Contents:

UNIT I: Introduction to System and Design
Mechatronics system, Types of systems, integrated design issue in mechatronics, Mechatronics key elements, Mechatronics design process, Advance approaches in Mechatronics

UNIT II: System modeling

Needs and methods of mathematical modeling, modeling of Electrical Systems, Mechanical translational systems, Mechanical rotational systems; Fluid systems, Coupled systems

UNIT III: Electro-Mechanical Modeling and Drives

Modeling of Mechanical Systems for Mechatronics, Applications, Structures and Materials, Four quadrant servo drives, Pulse width modulation drives, and Variable frequency drives

UNIT IV: Data acquisition and Real time interfacing & simulation system

Elements of Data Acquisition and Control system, Signal conditioning, Multiplexers, ADC/DAC process and its applications in mechatronics, Input/output card and software, Application software, Human Machine Interface (HMI), Real time systems, simulations, Software and tools (LabVIEW and MATLAB) for simulation, Simulation of sensors, Simulation of actuating devices, Simulation of signal conditioning devices, Mechatronics Case studies

UNIT V: Automotive Mechatronics

Automotive networking, bus systems, Automotive sensors, sensor measuring principles, sensor types, Electronic transmission control UNIT, modules for transmission control, Hydraulic modulator, electro-hydraulic brake, Electronic stability program, automatic brake functions

Text Books:

1. Mechatronics, Godfrey C. Onwubolu, Elsevier (2005).
2. Electronic Control Systems in Mechanical and Electrical Engineering, W. Bolton, Pearson (6th Ed., 2015)
3. Introduction to Mechatronics and Measurement Systems, David G. Alciatore, Michael B. Histand, McGraw Hill (5th Ed., 2019).
4. Applied Mechatronics, A. Smaili, F. Mrad, Oxford University Press (2008).
5. Mechatronics System Design by Devdas Shetty by Devdas Shetty, Richard A. Kolkm, Pws Publishing

Reference Books:

1. Mechatronics-Electronic Control System in Mechanical and Electrical Engineering by W. Bolton, Pearson
2. Introduction to Mechatronics and Measurement System by David G. Alciatore, Michael B. Histand, Tata Mcgraw Hill, India
3. Mechatronics by Tilak Thakur, Oxford University Press
4. Industrial Automated Systems, Terry L.M. Bartelt, Cengage (2010).
5. Mechatronics System Design, Devdas Shetty, Richard A. Kolk, Cengage (2nd Ed., 2010).

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEP308	Materials Testing and Characterization	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Describe principles of optical and electron microscopy.
CO2: Demonstrate the Bragg's law of diffraction and the principle of XRD.
CO3: Select the suitable characterization techniques for micro structural and compositional analysis of materials.
CO4: Identify the thermal analysis technique and apply them to determine various thermal events in materials.
CO5: Determine various methods of characterization that are appropriate for different material problems

Course Contents:

UNIT I:

Microscopy: Concepts of magnification, Resolution, numerical aperture, depth of field, principles of image formation, DIC illumination, hot stage microscopy, advantages, and limitations

UNIT II:

Fundamental of Optics: Optical microscope and its instrumental details, variants in the optical microscopes, image formation in optical microscope, phase contrast, polarized light, Differential interference contrast, fluorescence microscopy, sample preparation, applications of optical microscopes

UNIT III:

Scanning Electron Microscopy: Introduction to scanning, electron microscopy (SEM), various imaging techniques, spectroscopy, sample preparation, applications of SEM, SEM Parameters: Electron specimen interaction, working principles, lens arrangement, mode of imaging, bright field image, dark field image, image contrast, SAD, Comparison of OM, SEM and TEM, Advantages, limitations

UNIT IV:

XRD Analysis: Fundamentals of X-Ray scattering, Bragg's law derivation, factors affecting the intensity, crystallite size, effect of strain on the intensity, profile fit, indexing, peak broadening, quantitative analysis, residual stress analysis, instrumentation details, demo experiments of XRD

UNIT V:

Transmission Electron Microscopy: Introduction, diffraction and image formation, various imaging techniques, spectroscopy, sample preparation, applications of TEM, instrumentation details, demo experiments of TEM

References:

1. Material Characterization Techniques by Sam Zhang, Lin Li, Ashok Kumar, Crc Press
2. Characterization of Materials by P.K Mitra, Phi Learning

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEP309	Automotive Electrical & Electronics System	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Explain the construction of battery used in automotive vehicles.
CO2: Describe the construction and working of cranking motor, D. C. generator, alternator, ignition systems along with trouble shooting.
CO3: Discuss the faults arising in automotive wiring and lighting system.
CO4: Explain various chassis electrical systems, Describe transducers and sensors
CO5: Explain various aspects of electrical and Hybrid vehicles

UNIT I:

Introduction: Earth return and insulated systems, 6volts and 12 volts' system, fusing of circuits, low and high voltage automobile cables, cable specifications, diagram of typical wiring system, and symbols used in automobile electrical systems.
Storage Battery: Principle of lead acid cells, plates and their characteristics containers and separators, electrolyte and their preparation, effect of temperature on specific gravity of electrolyte, battery capacity and efficiency, battery rating, battery testing, methods of charging from D.C. mains, defects and remedies of batteries, care of idle and new batteries, different types of batteries and their principles like alkaline, lithium and zinc air etc

UNIT II:

Generator/ Alternator: Principle of generation of direct current, generator details, shunt dynamos, armature reaction, action of three brush generator and battery in parallel, setting of third brush, voltage and current regulators, cutout relay - construction, working and adjustment, Construction and working of alternator and output control.
Starter Motor & Drives: Battery motor starting system, condition at starting, behavior of starter during starting, series motor and its characteristics, considerations affecting size of motor, types of drives, starting circuit

UNIT III:

Ignition systems: Ignition fundamentals, working of battery and magneto ignition systems, comparison of battery and magneto ignition system, advantages and disadvantages of conventional ignition systems, Types of solid state ignition systems, components, construction and working, high energy ignition distributors, Electronic spark timing 10 Hours control.
Lighting system and Dashboard Instruments: Principle of automobile illumination, head lamp mounting and construction, sealed beam auxiliary lightings, horn, windscreen-wipers, signaling devices, electrical fuel pump, fuel, oil and temperature gauge, speedometer, odometer, etc. (Dash board instruments)

UNIT IV:

Engine management Systems: Combined ignition and fuel management systems. Exhaust emission control, Digital control techniques – Dwell angle calculation, Ignition timing calculation and Injection duration calculation. Complete vehicle control systems, Artificial intelligence and engine management, Hybrid vehicles and fuel cells.
Chassis Electrical systems: Antilock brakes (ABS), Active suspension, Traction control, Electronic control of automatic transmission, other chassis electrical systems, Central locking, Air bags and seat belt tensioners, seat heaters.

UNIT V:

Electrical and hybrid vehicles: Components of an EV, EV batteries, chargers, drives, transmission and power devices, Advantages and disadvantages of EVs. Hybrid electric vehicles, HEV drive train components, advantages of HV.
Transducers and sensors: Definition and classification, principle of working and application of various light sensors, proximity sensors and Hall effect sensors.

References:

1. Automobile Electrical and Electronic systems - Tom Denton, SAE publication, 2000
2. Automotive Electrical Equipment - P.M. Kohli, Tata McGraw Hill, New Delhi.

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEP310	Off Road Vehicles	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Restate the variety of phenomena covered in I.C. engine and their applications as earth moving vehicles.
CO2: Demonstrate knowledge and understanding regarding tractors and various equipment's involved in construction planning.
CO3: Predict different methods of construction planning and earth moving equipment's.
CO4: Describe fundamentals of automobiles used for Construction and Planning

Course Contents:

UNIT I:

Introduction and Requirements of off Road Vehicles: Machine, Equipment power requirements, Power Plants, Chassis and Transmission, Multiaxle vehicle, Cranes and Tractor-Introduction and applications, Land clearing machines, Earth moving machines Scrapers and graders, Shovels and Loaders, All Terrain Vehicles (ATV), Off-Road Vehicle Motorsports: MotoCross, Enduro along with desert racing like Dakar Rallye and Baja 1000

UNIT II:

Dozers: Introduction, Performance characteristics of Dozers, Pushing Material: Blades and their performance, Dozer Safety, Land Clearing Machines: Types of Equipment's used, Land Clearing Production Estimating, Rippers: determining the Rippability of rock, Rippers Attachments, Stampers

UNIT III:

Scrapers and Graders (Finishing Equipment's): Scrapers: Types, Operations, Performance charts, Production cycle, Production Estimation, Graders: Grader operation, Time Estimates, Fine Grading Production, Grader safety

UNIT IV:

Earth Moving Vehicles I: Shovels and Loaders (Excavators): Shovels: Selecting a front shovel, Calculating Shovel Production, Height of cut effect on shovel production, Angle of swing effect on Shovel Production, Capacity of Shovels, Loaders: Wheel and track loaders, Loaders Buckets/Attachments, Loader Production rates, Calculating wheel loader and track loader production

UNIT V:

Earth Moving Vehicles II: Cranes: Crane Types, Mobile Cranes: Crawler cranes, Telescoping-Boom truck mounted cranes, Lattice-boom truck mounted cranes, Rough terrain cranes, All-

Terrain cranes, Cranes Booms and Lifting capacities, Tower cranes: Classification, Operation, Tower cranes selection, Rated loads for tower cranes, Safety plans and programs, Draglines and Pile Driving Equipment's : Draglines: Description, dragline production, factor affecting dragline production, Clamshells and safety parameters, Pile Driving Equipment's: Classification, Pile Hammers: Types, supporting and positioning piles during driving, pile driving safety

Text Books:

1. Construction Planning, Equipment, and Methods by Robert L. Peurifoy
2. Clifford J. Schexnayder and AviadShapira, Mc Graw Hill Education

References:

1. Theory of Ground Vehicles by J. Y. Wong, Wiley

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEP311	Electrical Design & Aspects of HVAC	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: define the basic HVAC terminology, systems and design processes.
CO2: calculate the basic heating and cooling loads and component energy consumption using fundamental heat and mass balances on buildings and system components.
CO3: analyze the duct system for air distribution with the help of fans.
CO4: define industry standard methodologies for calculating building heating/cooling loads, and ventilation and building energy design requirements

Course Content:

UNIT I: Design conditions for human comfort & Heat transfer through building structures

Choice of inside design conditions, Comfort, outside design conditions, Choice of supply design conditions, Critical loading conditions, clean spaces, Fabric heat gain, Overall heat transmission coefficient, Periodic heat transfer through walls and roofs, Finite difference approximation of one-dimensional heat transfer through wall, Empirical methods to evaluate heat transfer through walls and roofs, Natural ventilation through infiltration, Passive heating and cooling of buildings, Water vapor transfer through structures

UNIT II: Design load calculation and applied psychometrics

Preliminary considerations, Internal heat gains, System heat gains, Break-up of ventilation load and effective sensible heat factor, Calculation of cooling and heating load, Psychometric calculations for cooling, Selection of air conditioning apparatus for cooling and dehumidification, Evaporative cooling, Building requirements and energy conservation in air-conditioned buildings

UNIT III: Design of air conditioning apparatus

Air conditioning apparatus, Heat and moisture transfer in air conditioning apparatus, Coil equipment – design of cooling and dehumidifying coils, Optimal design of cooling and dehumidifying coils, Spray equipment – design of air washers and cooling towers

UNIT IV: Design of duct for air distribution and fans

Room air distribution, Total, static and velocity pressures, Friction and dynamic losses in ducts, Air flow through a simple duct system, Air-duct design, Processing transmission and distribution of air in clean rooms, Air locks, Air curtains and air showers

UNIT V: Fan and its characteristics

Types of fan, Fan characteristics, Centrifugal fans – comparison of characteristics of backward and forward curved blade fans, Axial flow fan, System characteristic – system in series and in parallel, Fan-system interaction, Effect of change in fan speed and air density, Simple fan and system network, Fan arrangements in series and parallel

Text Books:

1. Refrigeration and Air-Conditioning by Arora, C. P., Tata Mcgraw Hill, India

References:

1. Air-Conditioning Principles and Systems – An Energy Approach by Pita, E. G., Pearson
2. HVAC Fundamentals (Vol. 3: Air-Conditioning, Heat Pumps, And Distribution Systems) By Brumbaugh, J. E., Wiley
3. Heating, Ventilating and Air-Conditioning: Analysis and Design By Mcquiston, F. C., Parker, J. D., Spitler, J. D., Wiley

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEP312	Introduction to Robotics	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs):

On completion of this course, the students will be able to:

CO1: Understand the concepts of mapping and transformation in field of robotics.
CO2: Analyze the kinematics and dynamics of robot manipulators.
CO3: Understand the applications of sensors in robots.
CO4: Identify the actuators used in robots

Course Contents:

UNIT I:

Introduction to robotics: Introduction to robots and robotics, Development of robots, Robot anatomy, Degrees of freedom, Robot classifications, Programming of robots, Various programming languages in robotics, Design and control issues in robotics, Applications of robotics in industry and other fields

UNIT II:

Coordinate Frames and Transformations: Coordinate frames, Mapping between frames, Description of objects in space, Transformation of Vectors, Inverting a homogenous transform, Fundamental Rotation matrices, and Equivalent angle axis representation

UNIT III:

Direct Kinematics: Description of links and joints, Kinematic modeling, DH Notations, Kinematic relation between adjacent links, Manipulator transformation matrix

UNIT IV:

Inverse Kinematics: Manipulator workspace, Solving of inverse Kinematic model, Existence of solutions and multiple solutions, Solution Techniques, Closed form Solutions, Guidelines for Closed form Solutions

UNIT V:

Differential Motion and Statics: Linear and angular velocity of a rigid body, Relation between transformation matrix and angular velocity, Mapping velocity vector, Velocity propagation along a link, Manipulator Jacobian, Jacobian Inverse, Jacobian singularities, Static Analysis, Actuators and Sensors : Hydraulic and pneumatic actuator, DC Motor, Stepper motor, Servo motor, AC motor, Sensors in robotics, Optical encoders, Choosing the right sensor, Robotic vision

Text Books

1. Robotics and Control by R. K. Mittal, I. J. Nagrath, Mcgraw Hill Education

Reference Books:

1. Introduction to Robotics: Analysis, Control, Applications by Saeed B. Niku, Wiley

2. Introduction to Robotics by S K Saha, Mcgraw Hill Education

3. Industrial Robotics: Technology, Programming and Applications by Nicholas Odrey, Mitchell Weiss, MikellGroover, Roger N Nagel, Ashish Dutta, Mcgraw Hill Education

4. Introduction to Robotics: Mechanics and Control by John J. Craig, Pearson

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEP313	Power Plant Engineering	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Describe sources of energy and types of power plants.
CO2: Analyze different types of steam cycles and estimate efficiencies in a steam power plant.
CO3: Describe basic working principles of gas turbine and diesel engine power plants.
CO4: Define the performance characteristics and components of such power plants

UNIT I:

FUEL COMBUSTION EQUIPMENTS
Types of combustion, stokers, fuel and ash handling equipments, Draft - forced, induced and balanced drafts, Selection of fan, Heat recovery equipments economizers, air preheaters and reheaters, different types of super heaters and de super heaters, Emission control, flue gas cleaning, particulate and gaseous emission control metho.

UNIT II

THERMAL POWER PLANT SYSTEMS
Steam generators forced circulation, high-pressure boilers and super critical boilers, fluidized bed boiler, boiler accessories and mountings. Boiler testing, Condensers: Different types, design factors, air removal, and performance calculation. Cooling towers - natural and mechanical draft types

UNIT III:

NUCLEAR, DIESEL AND GAS TURBINE POWER PLANTS
General nuclear fuels used in reactors, elements of nuclear reactor, moderator, control rods, coolants, description of different types of reactors. Radiation hazards, radioactive waste disposal, Diesel power plant - Classifications, components, selection of engine type. Gas turbine plant - closed and open cycles. Combined power cycles.

UNIT IV:

RENEWABLE ENERGY SOURCES Solar energy - measurement, methods of utilization, flat plate and concentrating collectors, water heater, air driers, photovoltaic cell, Wind energy - Horizontal and vertical axis wind turbines. Geothermal plants, tidal power plant, biomass and biogas plants, OTEC plants.

UNIT V:

POWER PLANT ECONOMICS Plant load factor and utilization factor, cost economics - Tariff rates, demand changes, load distributions. Energy conservation and audit. Maintenance aspects of power plants.

Text Books-

1. Power Plant Engineering by P.K. Nag, Tata McGraw Hill.
2. Steam & Gas Turbines & Power Plant Engineering by R. Yadav, Central Pub.House.

Reference Books-

1. Power Plant Engineering" F.T. Morse, Affiliated East-West Press Pvt. Ltd, New Delhi/Madras

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEP314	Principles of Material Selection	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Describe the material selection process with the help of material chart.
CO2: Identify various material processing techniques through case studies.
CO3: Analyze the impact of material selection by various case studies.
CO4: Analyze the impact of material selection on industry
CO5: Use of proper selection of materials for Eco environment

UNIT I: Fundamentals of Material Selection

Introduction and Synopsis, Materials in Design, Evolution of Engineering Materials, Evolution of Materials in Products, Design Process, Types of Design, Design Tools and Materials Data, Function, Material, Shape and Process

UNIT II Engineering Materials and Selection Charts

Brief History, Families of Engineering Materials, Materials Information for Design, Material Properties and their UNITs, Exploring Material Properties, Material Property Charts

UNIT III: Material Selections

Basics of Material Selection, Selection Procedure, Case Studies: Materials for Oars, Materials for Flywheels, Materials for Seals, Materials for Passive Solar Heating

UNIT IV: Material Process Selections

Introduction to Material Processing, Classification Processes, The Processes: Shaping, Joining, Finishing, Processing for Properties, Systematic Process Selection, Ranking: Process Cost, Computer-Aided Process Selection, Case Studies: Spark Plug Insulators, Manifold Jacket, Joining A Steel Radiator, Surface-Hardening A Ball-Bearing Race

UNIT V: Material and Environment

Introduction, Material Life-Cycle, Material and Energy-Consuming Systems, Eco-attributes of Materials, Eco-selection, Introduction to Bio-Degradable Composite, Case Studies on: Drink Containers and Crash Barriers

Text Books:

1. Materials Selection in Mechanical Design by Michael Ashby, Butterworth- Heinemann (Elsevier)

References:

1. Materials Science and Engineering by William D. Callister, R. Balasubramaniam, Wiley
2. Plant Design and Economics for Chemical Engineers by Max S. Peters, Klaus D Timmerhaus, Ronald E. West, Mcgraw Hill Education

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEP315	Power Electronics for Electric Vehicle Application	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Knowledge of different electric vehicles and their environmental impac.
CO2: Knowledge of different types of converters used in electric vehicles.
CO3: Knowledge of current sensors and speed sensors used in electric vehicles.
CO4: Knowledge of charge controllers and batteries used in electric vehicles
CO5: Identify different types of electric vehicles

UNIT I: Introduction of Electric Vehicles

Introduction, Types of electric vehicles, History of Electrical Vehicles (EV), Configurations of Electric Vehicles, Relative merits and their limitations, Applications, Environmental impact

UNIT II: Converters

Introduction and working of semiconductor power diode, Thyristors and MOSFET. Power electronic converters: DC-DC and DC-AC converters for electric and hybrid vehicles

UNIT III: Motors & Sensors: EV motors

PMDC, Series motors, Induction Motors, Switched reluctance motor. Sensors: Hall Effect sensors, optical encoders, current and speed sensing, closed loop speed control of vehicle

UNIT IV: Battery and Charge Controllers: Battery

Basic, Type, Parameters, Capacity, Discharge Rate, State of Charge, Depth of Discharge, Characteristics, Properties of Batteries. Charge Controllers: Purpose, Working and Limitations

UNIT V: Electric Vehicles: Hybrid Electric Vehicles

Types, Performance Parameters, Advantages and Disadvantages, Limitations. Electric Cars: Emerging Trend, Hybrid Cars, Acceleration and Speed Characteristics, Fuel Cell Vehicles: Fundamentals, Advance Hybrid Electric Vehicles

References:

1. James Larminie, "Electric Vehicle Technology Explained", John Wiley & Sons, 2003.
2. Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles Fundamentals", CRC Press, 2010
3. Sandeep Dharmeja, "Electric Vehicle Battery System", Newnes, 2011

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEP316	Vehicle Body Engineering	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Understand types of commercial vehicles; design of cab and in aerodynamic testing, forces and moments.
CO2: Evaluate about different aspects of car body and bus body, types, commercial vehicle.
CO3: Analyze the Role of various aerodynamic forces and moments, measuring instruments.
CO4: Evaluate about different aspects of car body and bus body, types, commercial vehicle
CO5: Identify the material which can be used in car body, bus body of an automobile vehicle. painting process for a commercial vehicle and tools used for body repairs

UNIT I: CAR BODY DETAILS

Types of Car body - Saloon, convertibles, Limousine, Estate Van, Racing and Sports car – Visibility regulations, driver's visibility, Improvement in visibility and tests for visibility, Driver seat design -Car Body Construction-Various panels in car bodies, Car body construction; design criteria, Crash tests on full scale model, Dummies and Instrumentation, Safety aspect of car body.

UNIT II: BUS BODY DETAILS

Types of bus body: based on capacity, Distance traveled and based on construction, Bus body lay out for various types, Floor height, engine location, entrance and exit location, seating dimensions, Types of metal sections used – Regulations, Constructional details: Conventional and integral

UNIT III: COMMERCIAL VEHICLE DETAILS

Types of commercial vehicle bodies, Light commercial vehicle body, Construction details of commercial vehicle body -Flat platform body, Trailer, Tipper body and Tanker body, Drivers cab design - Regulations

UNIT IV: BODY MATERIALS AND BODY REPAIR

Types of materials used in body Construction-Steel sheet, timber, plastics, GRP, properties of materials, Hand tools-power tools-panel repair-repairing sheet metal repairing plastics-body fillers-passenger compartment service- corrosion and Anticorrosion methods, Modern painting process procedure-paint problems and Body Types of Car body - Saloon, convertibles, Limousine, Estate Van

UNIT V: SPORTZ CARS

Racing and Sports car – Visibility regulations, driver's visibility, improvement in visibility and tests for visibility, Driver seat design -Car Body Construction, Various panels in car

bodies, Car body construction; design criteria, Crash tests on full scale model, Dummies and Instrumentation, Safety aspect of car body

TEXT BOOKS:

1. Powloski, J., "Vehicle Body Engineering", Business Books Ltd., 1998
2. James E Duffy, "Body Repair Technology for 4-Wheelers", Cengage Learning, 2009.

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEP317	HVDC Design	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Define basic HVAC terminology and fundamentals.
CO2: Discuss the working knowledge of different types of heating systems.
CO3: Discuss the air-conditioning systems for the different weather conditions
CO4: About human comfort and basics of air- conditioning.
CO5: About psychometric of air conditioning processes

UNIT-I: ADVANCED VAPOUR COMPRESSION CYCLES

Advanced Vapour Compression Cycles: Review of vapour compression cycle, Effect of superheating, Sub-cooling, Condenser pressure and evaporator pressure on COP, Ejector refrigeration cycle, Presentation of cycle on P-h and T-s chart, Refrigerants: Classification of Refrigerants, CFC, HFC, HCFC, Azeotropic, Zeotropic, Natural refrigerant, Secondary Refrigerant, Anti-freeze solution, Phase Changing Materials, Desired properties of refrigerants, Requirements for refrigerant, Classification based on safety, Refrigerant oils and applications, Properties and uses of commonly used refrigerant, Greenhouse effect, Global warming

UNIT-II: REVIEW OF PSYCHROMETRY

Review of Psychrometric: Psychrometric properties, Psychrometric chart and Psychrometric processes, Psychrometric process in Air conditioning equipment By pass factor, Cooling and dehumidifying coils, Apparatus dew point (ADP), Heating coils, Air washer, Use of hygroscopic solution in Air Washer, Adiabatic dehumidifier, Water injection, stream injection, Summer Air conditioning, Winter Air conditioning, Sensible heat factor (SHF), Grand Sensible heat factor (GSHF), Design Condition: Choice of inside design condition- cold storage, Industrial air conditioning, Comfort air conditioning, Human comfort, Outside design condition.

UNIT-III: HEAT PUMP & VENTILATION

Heat Pump: Introduction, Package heat pump with reversible cycle, Decentralized heat pump, Heat pump with a double bundle condenser, Industrial heat pump, Ventilation: Introduction, Purpose of ventilation, Natural ventilation, Mechanical ventilation, tunnels ventilation, mine ventilation, Natural ventilation, and mechanical ventilation, Air Conditioning system: Introduction, UNITary system, Central air conditioning system, Directs expansion system, All water system, all air system, air water system.

UNIT-IV: LOAD CALCULATION

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEP318	Robotic Programming & Simulation	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: identify the basics of MATLAB and its implementation in robotics.
CO2: apply MATLAB to solve the kinematics problems in robotics.
CO3: visualize the working of VEX robot and Firebird V robot kits.
CO4: observe the application of sensors and actuators in robots

UNIT I: Introduction to MATLAB

To understand the basics of MATLAB, Creating and accessing arrays, use of 'input' command and predefined functions in MATLAB, to learn to use conditions and loops, functions and graphs in MATLAB, to create a Graphical User Interface (GUI) in MATLAB

UNIT II: Mathematics of Robots

To determine the position of end effector of a cylindrical arm robot for any value of joint parameters, to determine the position of end-effector of an articulated arm robot, Inverse Kinematic Problem, to determine joint-link parameters of a Cartesian robots, to solve inverse kinematic problem for SCARA robot, Manipulator Jacobian to determine Manipulator Jacobian for a 3-link planar robot

UNIT III: Introduction to Robotics and Programming

Fundamental Robotic Terms & Concepts, Robotic Safety, Components of Robot, Control Movement of Robot, how to Connect the Robot to PC and Program it, learn to assemble different configurations of VEX robot including sensors and programming of controller of VEX robot and Firebird V robot

UNIT IV: Physics and Robotics

Concept of Speed in Robots, how to Use & Control Motors, Study Angular Velocity, Linear Motion, Friction & Torque in Robots, assemble a Robot to Pull Weights

UNIT V: Sensors in Robots & Robot Mechanics

Learn to Use Sensors in Robots to Assemble a Robot that Follows a Line, To Study Effect of Arm & End-Effectors on CG & Inertia, Control Robot in Play Field, learn to Use Gears, Chains & Other Mechanical Components in Robots

TEXT BOOKS:

1. Industrial Robotics: Technology, Programming and Applications by Mikell P. Groover, Tata Mcgraw Hill, India
2. Introduction to Robotics by S K Saha, Mcgraw Hill Education (India) Private Limited

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEP319	Surface Engineering	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Describe the fundamental concepts of coating and need of surface engineering
CO2: Develop the knowledge about the characterization of coatings
CO3: Identify the difference between metallic and non-metallic coatings
CO4: Compare the different modern coating process on application basis

UNIT I: Introduction to Surface engineering and its need

History and development of surface engineering (SE), fundamentals of SE, Concept and significance of SE, General areas of activity of SE, Main damage mechanism of material during fatigue, wear and corrosion, benefits of surface engineering for life enhancement of materials

UNIT II: Concept of Superficial Layer (SL)

Basic concept of SL, shaping and structure of SL, significance of superficial layer, potential properties of SL- general characteristics, metallographic structure, hardness, brittleness, diffusion, adhesion, adsorption and absorption, fatigue strength, tribological properties of SL

UNIT III: Concept of Coating and different techniques (Metallic and Non-metallic coating)

Basic concept and need of surface coating, classification of coating- based on material, based on application, based on manufacturing method, metallographic and mechanical characterization of coatings, Hot dip/immersion coatings, galvanizing, galvanneal, aluminium, tin coatings, electrochemical coatings, copper, nickel, chromium coating, thermal spray coating, cladded coating, protective and decorative coatings

UNIT IV: Special and advanced coating technology

Basics of chemical and physical vapour deposition technologies, Main characteristics and properties of CVD and PVD coatings, applications of CVD and PVD, Thermo-mechanical and thermo-chemical techniques, electron beam technology, Laser technology, Ion-implantation technology, application of the various coating process

UNIT V: Physico-chemical parameters and properties of coatings

General characteristics and structure of metallic coating, residual stresses, adhesion, hardness, ductility of coating, Electrical and Magnetic properties of coating, role of porosity, permeability and corrosion resistance properties in service life of coating

Text Books:

1. Surface Engineering of Metals by Tadeusz Burakowski, Tadeusz Wierzchon, CRC Press

References:

1. Fundamentals of Tribology by S. K. Basu, S.N Sengupta, B.B Ahuja, Phi Learni

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEP320	Vehicle Dynamics	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	Kinematics of Machines, Dynamics of Machinery (Mechanical Engineering), Automobile System, Physics (Automobile Engineering)				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Understand the dynamics of vehicle ride
CO2: Calculate and refer the loads and forces associated to the vehicles
CO3: Analyse the behavior of the vehicles under acceleration, ride and braking

UNIT I: Performance Characteristics of Vehicle

SAE Vehicle axis system, Forces & moments affecting vehicle, Earth Fixed coordinate system, Dynamic axle loads, Equations of motion, transmission characteristics, vehicle performance, power limited and traction limited acceleration, braking performance, Brake proportioning, braking efficiency

UNIT II: Aerodynamics & Motorcycle Dynamics

Mechanics of Air Flow Around a Vehicle, Pressure Distribution on a Vehicle, Aerodynamic Forces, Drag Components, Aerodynamics Aids, Kinematic structure of motorcycle, geometry of motorcycles, importance of trail, Resistance forces acting on motorcycle (tyre rolling resistance, aerodynamic resistance forces, resistant force caused by slope), Location & height of motor cycle's centre of gravity (C.G), Moments of inertia on Motorcycle. Introduction to Front & Rear suspensions of Motorcycle

UNIT III: Tire Mechanics

Tire Construction, Size and Load Rating, Terminology and Axis System, Tractive Properties, Cornering Properties, Camber Thrust, Aligning Moment, Combined Braking and Cornering, Conicity and Ply Steer, Slip, Skid, Rolling Resistance, Elastic Band Model for longitudinal slip, Simple model for lateral slip, Combined longitudinal/lateral slip (friction ellipse), Taut string model for lateral slip, Magic Tire Formula

UNIT IV: Suspensions

Suspension Kinematics, Suspension types, Solid Axles, Independent Suspensions, Anti-Squat and Anti-Pitch Suspension Geometry, Anti-Dive Suspension Geometry, Roll Center Analysis, Suspension Dynamics, Multi-body vibration, Body and Wheel hop modes, Invariant points, Controllable Suspension Elements: Active, Semi-Active. Choice of suspension spring rate, Calculation of effective spring rate, Vehicle suspension in fore and apt directions

UNIT V: The Steering System

The Steering Linkages, Steering System Forces and Moments, Steering System Models, Steering Geometry, Steady Handling (2 DOF steadystate model), Understeer and Oversteer, Effect of Tire Camber and Vehicle Roll (3 DOF steady-state model), Transient Handling and Directional Stability (2 DOF unsteady model), Effect of Vehicle Roll on Transient Handling (3 DOF unsteady model), Steady-State and Transient Handling of Articulated Vehicles

Reference Books:

1. Hans Pacejka, Tire and Vehicle Dynamics, Elsevier, 2012.
2. Thomas D Gillespie, "Fundamentals of Vehicle dynamics", SAE USA 1992
3. Rajesh Rajamani, Vehicle Dynamics & control, Springer
4. R.V. Dukkipati, Vehicle dynamics, Narsova Publications
5. Wong J Y, "Theory of Ground Vehicles", John Wiley & Sons, New York, 1978
6. Milliken W F and Milliken D L, Race car Vehicle Dynamics, SAE
7. Garrett T K, Newton K and Steeds W, "Motor Vehicle", Butter Worths & Co., Publishers Ltd., New Delhi, 2001
8. Heinz Heister, "Vehicle and Engine Technology", SAE Second Edition, 1999
9. Vittore Cossalter, Motorcycle Dynamics, 2nd Edition, Publisher: LULU.com
10. R N Jazar, Vehicle Dynamics: Theory and Application, Springer.

List of Open Source Software/learning website: http://nptel.ac.in/courses/107106080/

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Open Electives: I, II, III & IV

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Name of Program	Bachelor of Technology (Mechanical Engineering)				
BME0401	Measurement & Quality	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: explain of basics of Measurement system.
CO2: identify the working of time, pressure a strain measuring instruments.
CO3: Students should be able to Quality environment of the organization.
CO4: Student should be able to know international/national Quality award

UNIT I:

Significance of measurement, types of measurement, classification of instruments, Static terms and characteristics- Range and Span, Accuracy and Precision, Reliability, Calibration, Hysteresis and Deadzone, Drift, Sensitivity, Threshold and Resolution, Repeatability and Reproducibility, Linearity. Dynamic characteristics- Speed of response, Fidelity and Dynamic errors, Overshoot. Measurement of error: Classification of errors, environmental errors, signal transmission errors, observation errors, operational errors. Transducers: Classification of transducers, active and passive

UNIT II:

Control systems: Block diagram of automatic control system, closed loop system, open loop system, feedback control system, feed forward control system, servo motor mechanism

UNIT III:

Displacement measurement: Capacitive transducer, Potentiometer, LVDT, RVDT, Specification, selection & application of displacement transducer. Temperature measurements: Non-electrical methods-bi metal and liquid in glass thermometer, pressure thermometer. Electrical methods-RTD, platinum resistance thermometer, thermistor, Thermo electric methods elements of thermocouple, law of intermediate temperature, law of intermediate metals, thermo emf measurement. Quartz thermo-meter, Pyrometers- radiation and optical

Flow measurements: Variable head flow meters- Venturi, Flow nozzle, Orifice plate, Pitot tube, Variable area meter- Rotameter, Variable velocity meter-Anemo meter, Special flow meter-Hot wire anemometer, Electromagnetic flow meter, Ultrasonic flow meter.

UNIT IV:

Quality Concepts
Evolution of Quality control, concept change, TQM Modern concept, Quality concept in design, Review off design, Evolution of proto type
Control on Purchased Product

Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure

Manufacturing Quality

Methods and Techniques for manufacture, Inspection and control of product, Quality in sales and services, Guarantee, analysis of claims

UNIT V:

Total Quality Management: Principles and concept of total quantity management. Quality Audit: Concept of audit practices, lead assess or certification. Six-sigma: Statistical meaning, methodology of system Improvement, ISO 9000 Series & other standards: Concept, ISO 9000 series quality standards, QS14000, Statistical Quality Control– Meaning and importance of SQC, Variable and at tribute Measurement. Acceptance Sampling– Concept, Comparison with100% inspection, Different types of sampling plans, with merits and demerits.

REFERENCE BOOKS: -

1. Beckwith Thomas G., Mechanical Measurements, Narosa Publishing House, N. Delhi.
2. Doeblein E.O., "Measurement Systems, Application Design", McGraw Hill, 1990.
3. Kumar D.S., "Mechanical Measurements and Control", Metropolitan, N. Delhi.
4. Hume K.J., "Engineering Metrology", MacDonald and Co. 1963
5. Gupta, I.C., "Engineering Metrology", DhanpatRai& Sons, New Delhi, 1994
6. Sirohi, "Mechanical Measurement" New Age Publishers
7. Jain, R.K., "Engineering Metrology" Khanna Publishers

Text Books-

1. Lt. Gen. H. Lal, "Total Quality management", Wiley Eastern Limited, 1990.
2. Greg Bounds. "Beyond Total Quality Management". McGraw Hill, 1994.

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEO402	Organization Behaviour	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Comprehending the nature, functioning and design of organizations as social collectives.
CO2: To evaluate the reciprocal relationship between the organizational characteristics and managerial behavior.
CO3: Develop practical insights and problem solving capabilities for effectively managing the Organizational processes.
CO4: Analyzing the behavior of individuals and groups in organizations
CO5: Developing conceptual understanding of change and its implementation

Course Contents:

UNIT I:
Introduction to OB: The meaning of OB, why study organizational behaviour, Fundamentals of individual behavior, Determinants of Personality, types of personality, Personal effectiveness. Attitudes: Meaning, Types, Components, Theory of attitude formation and attitude change.

UNIT II:

Foundation of Group Behaviour: Group: Meaning, types, group dynamics, group cohesiveness, Meaning of Interpersonal, Behaviour & Interpersonal skills, Transactional Analysis, Johari Window, FIRO – B, MBTI

UNIT III:

Motivation: Meaning & definition, Traditional theory of Motivation: Maslow's, Herzberg's, McClelland, Contemporary theories of Motivation: Self Determination Theory, Self-Efficacy Theory, Vroom's Expectancy Theory, Equity Theory, Reinforcement Theory, OB MOD. Perception: Meaning, process, principles and errors of perception, managerial & behavioural applications of perception.

UNIT IV:

Leadership: What is leadership, types of leaders and leadership styles, traits and qualities of effective leader, trait theory, LSM – Leadership Situational Model, Team Building, Tuckman Model of Team Development.

UNIT V:

Organizational Change: Meaning of organizational change, approaches to managing organizational change, creating a culture for change, implementing the change, Kurt Lewin Model of change.

Reference Books:

1. Fred Luthans, Organizational Behaviourl, 12th Edition, McGraw Hill International Edition
2. Stephen P. Robbins, Organizational Behaviourl, 12th Edition, Prentice Hall
3. Aswathappa K, Organizational Behaviour (Text, Cases and Games) l, Himalaya Publication
4. UdaiPareek, Organizational Behaviorl, Oxford University Press.

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEO403	Engineering Materials	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: UNDERSTAND Understanding of the correlation between the internal structures of materials.

CO2: UNDERSTAND various methods to quantify their mechanical integrity and failure criteria

CO3: DISCUSS to provide a detailed interpretation of equilibrium phase diagrams.

CO4: APPLY Learning about different phases

CO5: UNDERSTAND Heat treatment methods to tailor the properties of Fe- C alloys

Course Contents:

UNIT I: Crystal Structure

Metallic crystal structures, Imperfection in solids, Point, line, interfacial and volume defects, Dislocation strengthening mechanisms, critically resolved shear stress, Mechanical Property measurement , Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, Generalized Hooke's law, ductility, resilience, toughness, Rockwell, Brinell and Vickers and their relation to strength

UNIT II: Static failure theories

Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Mohr-Coulomb and Modified Mohr-Coulomb, Effects of mean stress using the Modified Goodman diagram, Fracture with fatigue, Introduction to non-destructive testing (NDT)

UNIT III: Alloys, substitution and interstitial solid solution

Phase diagrams, Eutectic, peritectic, peritectoid and monotectic reactions, Iron Iron-carbide phase diagram, Austenite, ferrite and cementite, cast iron, Microstructure development

UNIT IV: Heat treatment of Steel

Annealing, tempering, normalizing and spheroidising, Iso- thermal transformation diagrams for Fe-C alloys, Continuous cooling curves, Properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, Flame and induction hardening, vacuum and plasma hardening

UNIT V: Alloying of steel

Properties of stainless steel & tool steels, cast irons- grey, white, malleable and spheroidal cast irons, copper and copper alloys, Aluminum and Al-Cu – Mg alloys, Nickel based super alloys and Titanium alloys

Books and References:

1. D. Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley India.
2. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. V. Raghavan, "Material Science and Engineering', Prentice Hall of India Private Limited, 1999.
4. Mechanics of materials by James M. Gere.
5. Introduction to engineering materials by B.K. Agarwal.
6. Physical metallurgy and advanced materials by R.E. Smallman.
7. Engineering mechanics of composite materials by Isaac M. Daniel.
8. U. C. Jindal, "Engineering Materials and Metallurgy", Pearson, 2011

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Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEO404	Bio-Materials	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Understand basics Bio-Materials.
CO2: Knowledge of Polymer used as Bio-Material.
CO3: Understand basics of Artificial Organs.
CO4: Predict the interaction between Bio-Materials and living tissue
CO5: Conclude the toxicity of Bio-Materials

Course Contents:

UNIT I:
Introduction: Definition of biomaterials, requirements & classification of biomaterials, Comparison of properties of some common biomaterials, Surface properties of materials of naturally occurring materials - Collagen, Bone, Teeth, Skin, causes of failure-micro cracks, crazing, fatigue., physical & mechanical properties of biomaterials.

UNIT II:
Different classes of materials used in medicine Polymers Synthesis -Mechanical & Thermal properties, Polyesters-Polyacrylates – Polyanhyrides, Biodegradable Polymers Hydrogels - Elastomer – Dendrimers, Metals Stainless steel - Cobalt-Chromium alloy. Titanium alloys. Ceramics and Bioglassesnonabsorbablebioceramics - biodegradable ceramics -bioreactive ceramics deterioration of ceramics Other Bioactive materials, Composites as biomaterials

UNIT III:
Sutures, wound dressings, artificial skin - Drug delivery devices - Cardiovascular medical devices Heart valves, Assist Devices-Stent and grafts, Orthopedic fixation devices - Internal-External - Joints, Total Hip Arthroplasty-Evolution-Design.

UNIT IV:
Material and Tissue interaction, biological environment and host response - Inflammation, Wound Healing and Foreign Body Response Failure mechanisms; corrosion, fracture, degradation of Implanted Materials-Polymers, Metals, ceramics.

UNIT V:
Testing of biomaterials: In-vitro, In-vivo preclinical tests-biocompatibility, Toxicological screening of biomaterials: Definition of biocompatibility, blood compatibility and tissue compatibility, Toxicity tests: acute and chronic toxicity studies (in situimplantation, tissue

culture, haemolysis, thrombogenic potential test. systemic toxicity. intracutaneous irritation test), sensitization, carcinogenicity, mutagenicity and special tests.

Text Books-

1. Biomaterials Science: An Introduction to Materials in Medicine, By Buddy D. Ratner, et al. Academic Press. San Diego, 1996.
2. JB Park. Biomaterials - Ser and Engineering. Plenum Press, 1984
3. Sujata V. Bhat, Biomaterials, Narosa Publishing House, 2002

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Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEO405	Assurance Value Engineering	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Discuss the concepts of value engineering, identify the advantages, applications.
CO2: Discuss various QualityDiscuss the concepts of value engineering, identify the advantages, applications, assurance certification and testing.
CO3: Learn the quality assurance role in companies
CO4: Analyze the various technique for testing
CO5: Learn and choose the better technique for product

Course Contents:

UNIT I:

Value engineering concepts, advantages, applications, problem recognition, role in productivity criteria for comparison, element of choice, Value engineering concepts, advantages, applications, Problem recognition, and role in productivity, criteria for comparison, element of choice

UNIT II:

Roles and Responsibilities of QA / QC Engineer Mechanical, Introduction to ISO 9001, ISO 9004, ISO 14000. ISO 19011, Interpretations of Quality Management Systems ISO 9001: 2015, International Codes and Standards, Standard Material Specifications, Types of Equipment, Piping and Fitting etc., QA / QC Requirements of Jobs / Projects, Receiving Inspection, In process Inspection & Final Inspection, Control of Nonconforming of Items / Products, Calibration of Monitoring & Measuring Equipment, Welding and NDT Requirements, Preparation of Project Quality Plan, Preparation of Inspection Test Plans – ITPs, Preparation of QC Procedure, Pressure Testing and Control of QA / QC Documents

UNIT-III:

Introduction to High-tech and QA, Background to High-tech, Roles in a modern company, Big high-tech companies vs. Small startups, what is QA, Software development life cycle, Modern software development methodologies, Waterfall / V o Agile / Scrum, Bug lifecycle

UNIT IV:

UNIT testing, Component testing, Integration testing, System testing, Black box and white box, Positive and negative testing, Smoke and sanity testing, Static and dynamic testing, Performance testing, Automation concept, Regression testing o Acceptance testing, Maintenance testing

UNIT V:

Selecting products and operation for value engineering action, value engineering programmes, determining and evaluating function(s)assigning rupee equivalents, developing alternate means to required functions, decision making for optimum alternative, use of decision matrix, queuing theory and Monte Carlo method make or buy, measuring profits, reporting results, Follow up, Use of advanced technique like Function Analysis System

Text Books-

1. Alphonse Dell'Isola, "Value Engineering: Practical Applications for Design, Construction, Maintenance & Operations", R S Means Co., 1997.
2. Richard Park, "Value Engineering: A Plan for Invention", St. Lucie Press, 1999.
3. Del L. Younker, "Value Engineering analysis and methodology", Marcel Dekker Inc, New York, 2004.
4. Miles, L.D., "Techniques of Value Analysis and Engineering", McGraw Hill second Edition, 1989.
5. Khanna, O.P., "Industrial Engineering and Management", Dhanpat Rai & Sons, 1993.
6. Anil Kumar Mukhopadhyaya, "Value Engineering Mastermind: From concept to Value Engineering Certification", SAGE Publications, 2003

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Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEO406	Tribology	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Have knowledge of surface topography and know how to model a rough engineering surface.
CO2: clear overall picture about the basics of tribology and related sciences, theoretical background about processes in tribological system, mechanisms and forms of interaction of friction surfaces.
CO3: Understand Hertz contact and rough surface contact.
CO4: Be familiar with adhesion theories and the effect of adhesion on friction and wear
CO5: Have a mastery of the friction/lubrication mechanisms and know how to apply them to the practical engineering problem
CO6: Know the methods to reduce the friction for engineering surface

Course Contents:

UNIT-I: Introduction to Tribology

Definition, Scope, Applications, Friction, Definition, Scope, Laws of friction, Friction theories, Surface contaminants, Effect of sliding speed on friction

UNIT-II: Wear

Definition, Scope, wear of metals, Types, Classification, Mechanism of wear, Quantitative laws, Hypothesis of Holm, Hypothesis of Burwell and Strang Hypothesis of Archard, Rawe, Rabinowicz, Quantitative law for Abrasive wear, Bayerku surface fatigue theory, Delamination theory & Fatigue theory of wear, wear resistant materials, Introduction to wear of Polymers and Ceramics. Wear reduction by Surface Improvements, Pitting, Erosion & Stress Corrosion.

UNIT-III: Surface Interactions

Elastic & Plastic deformation of surfaces, Contact of Solids, Contact of Ideally Smooth Surfaces, Distribution of Pressure over elastic contact of two curvilinear bodies, Formulae for calculation of contact area. Physico-Mechanical properties of surface layers, Characteristics of Surface Geometry, Classes of surface roughness, Contact of rough surfaces. Interaction of surface peaks. Real and contour area of contact

UNIT-IV: Lubrication

Definition & Scope, Generalized Reynold's equation, Flow and shear stress, energy equation, Mechanism of pressure development in bearings, Concept of Boundary Layer.

UNIT-V: Bearing design considerations & characteristics

Bearing design procedure & steps, Plain slider bearing. Step (Rayleigh step) bearing. Infinitely long journal bearing, infinitely short journal bearing, Future scope and applications

Text Books-

1.Introduction to Tribology of bearings by - B. C. Majumdar., S Chand & Co.
2.Hand Book of Tribology – WHILEY
3.Fundamentals of Fluid film lubrication by – Bernard Hamrock, McGraw Hill International Edition.

Reference Books-

1.Tribology in Industries by Sushil. K. Srivastava, S Chand & Publications.
2.Basic Lubrication theory by Alastair Cameron.

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Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEO407	Total Quality Management (TQM)	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Students should be able to Quality environment of the organization.
CO2: Student should be able to know the TQM approachfor manufacturing/service Organization in length.
CO3: Student should be able to know various Quality terms like Tolerance and Variability, PDCA cycle, Crosby's 10 points and Deming's 14 Points.
CO4: Student should be able to know international/national Quality awards

Course Contents:

UNIT-I:

Quality Concepts
Evolution of Quality control, concept change, TQM Modern concept, Quality concept in design, Review off design, Evolution of proto type
Control on Purchased Product
Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure
Manufacturing Quality
Methods and Techniques for manufacture, Inspection and control of product, Quality in sales and services, Guarantee, analysis of claims

UNIT-II:

Quality Management
Organization structure and design, Quality function, decentralization, Designing and fitting organization for different types products and company, Economics of quality value and contribution, Quality cost, optimizing quality cost, seduction programme.
Human Factor in Quality
Attitude of top management, co-operation, of groups, operator's attitude, responsibility, causes of operator's error and corrective methods.

UNIT-III:

Control Charts
Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts.
Attributes of Control Charts
Defects, construction and analysis off-chart, improvement by control chart, variable sample size, construction and analysis of C-chart.

UNIT-IV:

Defects Diagnosis and Prevention
Defect study, identification and analysis of defects, corrective measure, factors affecting reliability, MTTF, calculation of reliability, Building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle.

UNIT-V:

IS0-9000 and its concept of Quality Management:
ISO 9000 series, Taguchi method, JIT in some details

Text Books-

1. Lt. Gen. H. Lal, "Total Quality management", Wiley Eastern Limited, 1990. .
2. Greg Bounds. "Beyond Total Quality Management" McGraw Hill, 1994.

Reference Books-

1. Menon, H.G, "TQM in New Product manufacturing", McGraw Hill 1992

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEO408	Non Destructive Testing	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Select an appropriate NDT technique as per requirement.
CO2: Set various process parameters and control the NDT process for the desired output parameters.
CO3: Find the internal flaws in the material by NDT and take measures to eliminate them.
CO4: Solve various problems encountered like leakage, cracks, blowholes etc with the Manufacturing process by analyzing the data
CO5: To Competent enough to make use of modern tools and softwares for analyzing and solving real life problems.

Course Contents:

UNIT I:

Introduction: Fundamentals of an introduction to destructive and non-destructive testing. Scope and limitations of NDT, Visual examination methods, Different visual examination aids.

UNIT II:

Dye penetrant Testing Dye Penetrant Testing/ liquid penetrant testing: Principle, procedure, characteristics of penetrant, types of penetrants, penetrant testing materials, fluorescent penetrant testing method– sensitivity, application and limitations
Magnetic Particle Testing Magnetic Particle Testing: Important terminologies related to magnetic properties of material, principle, magnetizing technique, procedure, equipment, fluorescent magnetic particle testing method, sensitivity, application and limitations

UNIT III:

Ultrasonic Testing: Ultrasonic Testing: Basic principles of sound propagation, types of sound waves, Principle of UT, methods of UT, their advantages and limitations, Piezoelectric Material, Various types of transducers/probe, Calibration methods, use of standard blocks, technique for normal beam inspection, flaw characterization technique, defects in welded products by UT, Thickness determination by ultrasonic method, Study of A, B and C scan presentations, advantage, limitations acoustic emission testing – principles of AET and techniques

UNIT IV:

Radiographic testing: Radiographic testing: X-ray and Gamma-Ray radiography, Their principles, methods of generation, Industrial radiography techniques, inspection techniques,

applications, limitations, Types of films, screens and penetrameters. Interpretation of radiographs, Safety in industrial radiography

UNIT V:

Leak and pressure testing: Leak and pressure testing: Definition of leak and types, Principle, Various methods of pressure and leak testing, Application and limitation Eddy current testing: Eddy current testing: Principle, instrument, techniques, sensitivity, application, limitation Thermal methods of NDT

SUGGESTED TEXT BOOKS & REFERENCES:

1. ASM Metals Handbook, Non-Destructive Evaluation and Quality Control, American Society of Metals, Metals Park, Ohio, USA, 2, Volume-17.
2. ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Handbook, Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, Vol. 7, Ultrasonic Testing
3. Charles, J. Hellier, Handbook of Nondestructive evaluation, McGraw Hill, New York 21.
4. Paul E Mix, Introduction to Non-destructive testing: a training guide, Wiley, 2nd Edition New Jersey, 25

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEO409	Biomedical-Instrumentation	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Understand the use of transducer in Medical
CO2: Understand the basic of various medical equipment using voltage to measure vital signs
CO3: Understand the basic heart related equipment.
CO4: Understand the dialysis procedure and equipment involved.
CO5: Predict the effect of current on human body

Course Contents:

UNIT I:

Transducers - Classification & performance characteristics of transducers, Temperature transducers, Displacement transducer Pressure transducer catheter tip transducers, Photoelectric transducers.

UNIT II:

Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG), Electroretinogram (ERG), Recording Electrodes - Electrode-tissue interface, polarization, skin contact impedance, motion artifacts, Silver-Silver Chloride electrodes, Electrodes for ECG, Electrodes for EEG, Electrodes of EMG, microelectrodes.

UNIT III:

Pulmonary function analysers-Spirometry, Blood cell counters- Coulter counters, Cardiac Pacemakers, Cardiac Defibrillators, Lithotriptors, Block diagram & working of Cardio pulmonary bypass machine, Block diagram and working of X-ray machine.

UNIT IV:

Principle of dialysis, Artificial kidney, types, function and working of dialysis, Performance analysis of dialysis, Membranes used for hemodialysis, Block diagram and working of hemodialysis machine, Portable kidney machine working and flow diagram.

UNIT V:

Physiological effects of electrical currents, macro-shock and micro-shock, preventive measures to reduce shock hazards, Leakage current, isolation of patient circuits, safety of electrically susceptible patients, radiation hazards and safety, shielding, open ground problem and earthing methods.

Text Books:

1. R. S. Khandpur, Biomedical Instrumentation Technology and Applications, McGraw-Hill Professional, 2004.
2. Leslie Cromwell, Fred. J. Weibell and Erich. A. Pfeiffer, "Biomedical Instrumentation and Measurements", 2nd Edition, PHI, 2003. (UNIT I, III).
3. John G. Weber, Medical Instrumentation: Application and Design, 3rd edition, John Wiley & Sons, New York, 1998. (UNIT II).
4. Raja Rao, C, Guha, S.K, Principles of Medical Electronics and Biomedical Instrumentation, Orient Longman Publishers (2000) (UNIT V)

Reference Books:

1. R. Anandanatarajan, "Biomedical Instrumentation", PHI Learning, 2009.

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEO410	Design Methodology	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: At the end of this course Student will able to discuss the Scope of industrial management.

CO2: At the end of this course Student will able to explain the Level `s and contribution of management function.

CO3: Perform Problem Definition.

CO4: At the end of this course Student will able to explain the inventory control methods

CO5: At the end of this course student will able to discuss the quality control methods and their types

Course Contents:

UNIT I: Engineering Design

Introduction, Engineering Design Process, Ways to Think About the Engineering Design Process, Considerations of a Good Design, Description of Design Process, Computer-Aided Engineering, Designing to Codes and Standards, Design Review, Societal Considerations in Engineering Design

UNIT II: Product Development Process, Problem Definition and Need Identification

Factors for Success, Product and Process Cycles, Organization for Design and Product Development, Markets and Marketing, Technological Innovation, Identifying Customer Needs, Customer Requirements, Establishing the Engineering Characteristics, Quality Function Deployment, Product Design Specification

UNIT III: Team Behavior and Tools

Introduction, What It Means to be an Effective Team Member, Effective Team Meetings, Problems with Teams, Problem Solving Tools, Time Management, Planning and Scheduling

UNIT IV: Gathering Information

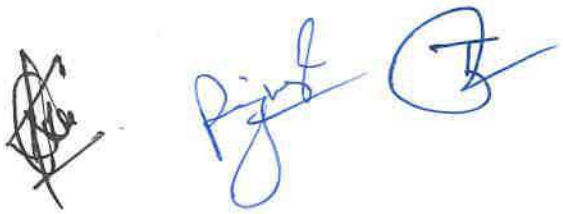
Introduction, the Information Challenge, Types of Design Information, Sources of Design Information, Library Sources of Information, Government Sources of Information

UNIT V: Concept Generations, Decision Making and Concept Selection

Introduction to Creative Thinking, Idea Generating Techniques beyond Brainstorming, Creative Methods for Design, Functional Decomposition and Synthesis, Morphological Methods, TRIZ: The Theory of Inventive Problem Solving, Axiomatic Design Introduction, Decision Making, Evaluation Methods, Embodiment Design

Text/Reference Books:

1. Design Thinking Methodology Book by EmrahYayici



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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEO411	Finite Element Analysis	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: understand the need of Finite Element Method in design of machine elements.
CO2: solve elasticity problems of truss and beam structures using FEM.
CO3: analyze the concept of plane stress and plane strain condition in structural applications using FEM.
CO4: analyze the 1-d and 2-d heat transfer problems using FEM.
CO5: analyze the accuracy of solution of FEM

Course Contents:

UNIT I: Introduction

What is the FEM and How FEM works, Introduction to ANSYS, Finite elements of an elastic continuum displacement approach, Type of coordinate systems in FEM, Type of elements, Introduction to shape function, Shape function of bar, beam and plane elements, Convergence requirement for shape function.

UNIT II: Introductions to Stiffness Matrix

Assembling stiffness equation using direct approach, assembling stiffness equations using variational method, Potential energy approach, Rayleigh-Ritz method, assembling stiffness equations using weighted residual method, Galerkin's method, Application to spring problems, Application to bar problems

UNIT III: Application to structural mechanic's problems

Elasticity Problems Application to Plane truss, Transformation of vectors in two dimensions, Stiffness of Truss Members, Stresses in each element, Reaction forces, Inclined or skewed supports, Beam element, Shear Force, bending moment and Fixed-end Reaction Vector, Load Vector Formulation: Point load and Uniformly distributed load, Plane stress and plane strains, Axisymmetric stress analysis

UNIT IV: FEM in Steady State Field Problems

Introduction, heat conduction, one dimensional heat transfer problems, Two dimensional heat transfer problems

UNIT V: Computer procedures for Finite element analysis

Accuracy of solution, Approximation of error, Common mistakes, Convergence of solution, Convergence with mesh refinement, Stress concentration &submodeling, Various measure of errors

Text Books

1. A First Course in Finite Element Method by Daryl L. Logan, Cengage Learning

Reference Books:

1. Introduction to Finite Element in Engineering by R. Chandrupatla, Pearson
2. Finite Element Analysis by S Sbhavikatti, New Age International
3. Finite Element Analysis Theory and Programming by C.S. Krishnamoorthy, Tata Mcgraw Hill, India
4. An Introduction to The Finite Element Method by J. N. Reddy, Mcgraw Hill Education

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEO412	I.C Engines	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Understand various types of I.C. Engines and Cycles of operation.
CO2: Analyze the effect of various operating variables on engine performance.
CO3: Identify fuel metering and fuel supply systems for different types of engines.
CO4: Understand normal and abnormal combustion phenomena in SI and CI engines.
CO5: Evaluate performance Analysis of IC Engine and compressor and justify the suitability of IC Engine for different application

Course Contents:

UNIT-I:

Introduction to I.C Engines: Engine classification and basic terminology, Two and four stroke engines, SI and CI engines, Valve timing diagram. Thermodynamic analysis of Air standard cycles, Otto cycle, Diesel cycle, Dual cycle, Stirling cycle, Ericsson cycles, Comparison of Otto, Diesel and Dual Cycles Fuel air cycle, factors affecting the fuel air cycle, Actual cycle.

UNIT–II:

SI Engines: Combustion in SI engine, Flame speed, Ignition delay, Abnormal combustion and its control, combustion chamber design for SI engines. Carburetion, Mixture requirements, Carburetors and fuel injection system in SI Engine Ignition system requirements, ignition timing and spark plug, Electronic ignition, Scavenging in 2 Stroke engines, Supercharging and its effect

UNIT–III:

CI Engine: Combustion in CI engines, Ignition delay, Knock and it's control, Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, Fuel injectors, Injection timings, Exhaust emissions from SI engine and CI engine and it's control

UNIT-IV:

Engine Cooling and Lubrication: Different cooling systems, Radiators and cooling fans, Engine friction, Lubrication principle, Type of lubrication, Lubrication oils, Crankcase ventilation. Fuels: Fuels for SI and CI engine, Important qualities of SI and CI engine fuels, Rating of SI engine and CI engine fuels, Dopes, Additives, Gaseous fuels, LPG, CNG, Biogas.

UNIT-V:

Compressors: Classification, reciprocating compressors, Single and Multi stage compressors, Intercooling, Volumetric efficiency, Rotary compressors, Classification, Centrifugal compressor, axial compressors, Surging and stalling, Roots blower, Vaned compressor.

Text Books-

1. Fundamentals of Internal Combustion Engine by Gill, Smith, Ziurs, Oxford & IBH Publishing CO.
2. Fundamentals of Internal Combustion Engines by H.N. Gupta, Prentice Hall of India
3. A Course in International Combustion Engines, by Mathur& Sharma, Dhanpat Rai & Sons.

Reference Books-

1. I.C Engine Analysis & Practice by E.F Obert.
2. I.C Engine, by Ganeshan, Tata Mc Graw Hill Publishers.
3. I.C Engine, by R. Yadav, Central Publishing House, Allahabad

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Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEO413	Rehabilitation Engineering	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Grasp the fundamentals of Rehabilitation Engineering.
CO2: Understand the basic of locomotor equipment.
CO3: Understand the basic of amputation and locomotor prosthetics.
CO4: Knowledge of visual prosthetics
CO5: Knowledge of external powered prosthetics

Course Contents:

UNIT I:

Introduction to Rehabilitation Engineering, Clinical practice of rehabilitation Engineering - Low technology tools Service delivery, Universal design - Design based on human ability - Standards for assistive technology, Test for best design

UNIT II:

Seating Assessment - Interventions in seating system - Biological aspects of tissue health, Support surface classification - Manual wheelchairs, Electric power wheelchair, Power assisted wheelchairs - Wheel chair standards & tests, Wheel chair Transportation-Ground mobility device

UNIT III:

Anatomy of upper & lower extremities - Classification of amputation types, Prosthesis prescription, Components of upper limb prosthesis - Fabrication of prosthesis Components of lower limb prosthesis, Orthoses: It's need and types - Lower extremity- and upper extremity-orthoses, Slints - materials used

UNIT IV:

Anatomy of eye, Categories of visual impairment - Cortical & retinal implants, Auditory Information Display - Blind mobility aids - reading writing & graphics access, Orientation & navigation Aids - Anatomy of ear - hearing functional assessment, Surgical and non surgical hearing aids, Assistive technology solutions for hearing.

UNIT V:

Externally powered and controlled orthotics and prosthetics, Myoelectric hand and arm prostheses, The marcus intelligent hand prostheses, gait study, spinal rehabilitation, Role of biomedical engineering in rehabilitation

Text books

1. Rory A Cooper, HisaichiOhnabe, Douglas A Hoon, -An Introduction to Rehabilitation Engineering". CRC Press, First edition, 2006

References

1. Marion A Hersh, Michael A Johnson, -Assistive Technology for Visually impaired and blind people" Springer Publications, First edition, 2008
2. Suzanne Robitaille, -The illustrated guide to Assistive technology and Devices-Tools and gadgets for living independently", Demos Health Newyork, First edition, 2010

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEO414	Reliability & Quality Control	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Understand the concepts of quality, quality assurance and management.
CO2: Demonstrate the ability to use the methods of statistical process control and able to use and interpret control charts for variables.
CO3: Use and interpret control charts for attributes, also able to understand sampling inspection.
CO4: Understand the concepts of reliability, carry out reliability data analysis.
CO5: Determine system reliability and get acquainted with reliability improvement methods.

Course Contents:

UNIT I: Introduction: Basic concepts of reliability
Objectives and use in industry, bath tub curve, failure mechanism, failure data analysis, failure rate, failure density, mortality rate, mean time to failure, mean time between failure and mean time to repair, reliability in terms of hazard rate and failure density, useful life and wear out phase of a system

UNIT II: System reliability and improvement

Various system configurations, reliability of series and parallel systems, Improvement in system reliability, element redundancy, UNIT redundancy, standby redundancy, concepts and definitions of various types of availability, three state devices

UNIT III: Maintainability

Introduction and objectives, relationship between reliability, Availability and maintainability, importance, types of maintenance, preventive maintenance, predictive maintenance, breakdown maintenance, corrective maintenance, condition based maintenance, concept of reliability centered maintenance

UNIT IV: Inspection

Definition and objectives, types of inspection: centralized inspection, decentralized inspection, functions of inspection, quality control, its need and functions, difference between inspection and quality control, limits and fits, classification of fits, measurement terminology: accuracy, interchangeability, tolerance, allowances, introduction to destructive and non-destructive testing, Introduction to quality, statistical concepts in quality, variation in quality, causes of variation: chance and assignable causes, types of control charts, control chart for variables, control chart for attributes, attribute chart for number of defects per UNIT: C-Chart, acceptance sampling, risks in acceptance sampling, process capability

UNIT V: Quality measurement tools and techniques

Seven basic tools, check sheet, control chart, stratification or flow chart, pareto chart, histogram, cause & effect diagram, scatter diagram, new seven tools, affinity diagram, inter relationship diagram, tree diagram, matrix diagram, arrow diagram, process decision program chart and matrix data analysis

Text/Reference Books:

1. Quality Management and Reliability by Sharma S. C., Khanna Publishers
2. Reliability Engineering by Srinath L. S., Affiliated East-West Press Private Limited
3. Statistical Quality Control: A Modern Introduction by Douglas C. Montgomery, Wiley
4. An Introduction to Reliability and Maintainability Engineering by Charles Ebeling, Tata McGraw Hill, India

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEO415	Six Sigma: Quality and Methodology	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Discuss the philosophy and basic concept of Six Sigma.
CO2: Understand the kano model and customer requirements.
CO3: Analyze the basic steps for implementation of Six Sigma in industry.
CO4: Apply the failure modes and effects Analysis.
CO5: Describe the basics of operational excellence

Course Contents:

UNIT I:

Six Sigma Introduction: Introduction to the Six Sigma, Six Sigma history, Methodology and DMAIC process improvement cycle, cost of quality, Process yield, becoming a customer and market-driven enterprise

UNIT II:

Customer Needs and Requirements: Customer expectations, Kano Model to categorize quality characteristics, Six Sigma project, Defining the Problem, key content in a Project Charter, customer needs & requirements, Linking six sigma project to strategies

UNIT III:

Six Sigma Quality Tools: Important tools used in process deviations, Failure Modes and Effects, Analysis, Eight Disciplines and Five Whys, Techniques for Design for Six Sigma (DFSS), Basic Six Sigma Metrics, Attributes to good metrics

UNIT IV:

Design for Six Sigma: DMAIC, zero defect, Design for Manufacturing (DFM), Design for Assemble (DFA) and Reliability Analysis, Six Sigma Basic Statistics, Methodology of six sigma implementation

UNIT V:

Six Sigma Strategy: Six Sigma: Strategic planning and Implementation, Six Sigma and Operational Excellence: Summary, Six Sigma: Case study and Tools, The Seven Elements of Waste, TQM vs. Six, Sigma-The Contrast Application of Six Sigma: Six Sigma for Supply Chain Management, TQM and quality chain, Taguchi Product Design Approach, Taguchi's Robust Design, Application of Six Sigma in Industry, Readiness for Six Sigma: Assessing the Organization

Text Books:

1. Six Sigma for Business Excellence: Approach Tools and Applications by Hemant Urdhwareshe, Pearson

References:

1. Simplified Six Sigma: Methodology, Tools and Implementation by N. Gopalakrishnan, Phi Learning
2. An Introduction to Six Sigma and Process Improvement by James R. Evans & William M. Lindsay, Cengage Learning

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEO416	Computer Graphics	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: To list the basic concepts used in computer graphics.
CO2: To describe the importance of viewing and projections.
CO3: To define the fundamentals of animation, virtual reality and its related technologies.
CO4: To understand a typical graphics pipeline.
CO5: To design an application with the principles of virtual reality.

Course Contents:

UNIT-I:

Recent development in Computer Graphics, Scope, Graphic standards and hardware requirements for interfacing

UNIT-II:

Raster scans graphics, fundamental requirement and plotting of a point, line drawing, DDA and Bresenham's line algorithm, circle generation using Bresenham's algorithm.

UNIT-III:

Two-dimensional transformation, basic and inverse geometric transformations, clipping and clipping algorithms, Elements of 3-D Graphics, Projections, representations of polygons and solid modeling

UNIT-IV:

Development of curves and surface using Bezier, Hermite and B-spline algorithms, Evaluation of Curves length, surface area and volume of objects of visual realism, Hidden line removals, and shading algorithms

UNIT-V:

Use of application software packages for drafting and Used of plotters, scanners drawing of simple, Assembly drawing using drafting packages

Text Books-

1. Engineering Drawing - N.D. Bhatt & V.M. Panchal, Charotar Publishing.
2. Computer Aided Engineering Drawing - S. Trymbaka Murthy, -I.K. International Publishing
3. Engineering Graphics - K.R. Gopalakrishna, Subhash Publishers

Reference Books-

1. Fundamentals of Engineering Drawing with an Introduction to Interactive Computer Graphics for Design and Production-Luzadder Warren J., Duff John M.
2. Engineering Drawing - M.B. Shah, B.C. Rana

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(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Name of Program	Bachelor of Technology (Mechanical Engineering)				
BMEO417	Therapeutic Equipment	L	T	P	C
Owning School/Department	Mechanical Engineering	3	0	0	3
Pre-requisites/Exposure	-				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Understand the basics of pacemaker, defibrillator etc.
CO2: Understand the basics of ventilators.
CO3: Understand the basics of equipment involved in muscular-nerve therepy.
CO4: Understand the basics of equipment involved in laser surgery.
CO5: Understand the basics of equipment involved in electro surgery.

Course Contents:

UNIT I:

Cardiac Pacemakers & Defibrillators: Effects of electric field on cardiac muscles and laws of stimulation, External, internal, and Programmable pacemakers, Pulse generator: sensing, output and timing circuits, Power sources, electrodes and leads system, pacing system analyzers, Defibrillators basic principle and comparison of output wave forms of different DC defibrillator, energy requirements, synchronous operation, implantable defibrillators, defibrillator safety and analyzers, RF ablation treatment for arrhythmia.

UNIT II:

Ventilators & Anesthetic system: Basic principles of ventilators, different generators, inspiratory phase and expiratory phase different ventilatory adjuncts, neonatal ventilators, p based ventilator, ventilator testing, Anesthesia: Need of anesthesia, gas used and their sources, gas blending and vaporizers, anesthesia delivery system, breathing circuits.

UNIT III:

Physical therapy: Physical therapy principles Electrical stimulators: Strength-duration curve, types of stimulators, an electro-diagnostic therapeutic stimulator, Nerve-muscle stimulator: peripheral nerve stimulator. Ultras onicstimulators, stimulators for pain and relief Diathermy: IR diathermy, UV diathermy, short wave diathermy, microwave diathermy, ultrasonic diathermy.

UNIT IV:

Surgical Diathermy & LASER: Principles and applications of surgical diathermy, Physics and engineering of ultrasonic lithotripter, basic principle of extracorporeal shock wave lithotripter, Principle operation of LASER, various application of CO_2, argon, He-Ne, Nd-YAG & pulsed ruby LASER, Application of LASER in surgery.

UNIT V:

Electro-surgery & Neonatal care UNIT: Electrosurgery machine, electrosurgery circuits, solid state electrosurgery generator circuits, electrosurgery safety, testing electrosurgery UNITs, cautery, light sources, suction apparatus, and sterilizers, Baby incubator, radiant warmer and phototherapy UNIT.

Text Books

1. R. S. Khandpur "Handbook of Bio-Medical Instrumentation", Tata McGraw Hill.
2. Carr& Brown, "Introduction to Biomedical Equipment Technology" Pearson Education, Asia
3. J. Webster, "Bioinstrumentation", Wiley & Sons

Reference Books:

1. Joseph Bronzino, "Biomedical Engineering and Instrumentation", PWS Engg., Boston. Willard Van Nostrand, "Instrumental Methods of Analysis".
2. Sharms, "Instrumental Methods", S Chand & Co.
3. Harry Bronzino E, "Handbook of Biomedical Engineering and Measurements", Reston, Virginia Jacobson &Websler." Medicine& Clinical Engg".
4. Leslie Cromwell." Biomedical Instrumentation and Measurements".
5. HeinzKresse. "Handbook of Electro medicine", John Wiley
6. Geddes &Baker, "Principles of Applied Biomedical Instrumentation" Wiley

Appemsix-2

Faculty of Engineering and Technology
Rama University, Kanpur
Department of Mechanical Engineering
Evaluation Scheme

I SEM

S No	Course Category	Course Code	Course Name	L	T	P	C	CA	MTE	ETE	Total
1	BSC	BCN1001	Mathematics-I	3	1	0	4	30	20	50	100
2	ESC	BCN1002	Electrical and Electronics Engineering	3	0	0	3	30	20	50	100
3	BSC	BCN1003/BCN2007	Physics	3	0	0	3	30	20	50	100
4	ESC	BCN1004	Problem Solving using Programming	3	0	0	3	30	20	50	100
5	ESC	BCN1005/BCN2008	Mechanical Engineering and Robotics	3	0	0	3	30	20	50	100
6	ESC	BCN1052	Electrical and Electronics Engineering Lab	0	0	2	1	30	20	50	100
7	BSC	BCN1053/2057	Physics Lab	0	0	2	1	30	20	50	100
8	ESC	BCN1054	Problem Solving using Programming Lab	0	0	2	1	30	20	50	100
9	ESC	BCN1055/BCN2058	Workshop/Manufacturing Practices Lab	0	0	2	1	30	20	50	100
			Total	**15**	**1**	**8**	20	**270**	**180**	**450**	**900**
			Total Up to 1st Semester				**20**				

II SEM

S No		Course Code	Course Name	L	T	P	C	CA	MTE	ETE	Total
1	BSC	BCN2001	Mathematics-II	3	1	0	4	30	20	50	100
2	BSC	BCN2002/1007	Chemistry	3	0	0	3	30	20	50	100
3	PCC	BCN2003	Engineering Mechanics	3	0	0	3	30	20	50	100
4	HSC	BCN2004/1008	Life Skills: Entrepreneurship, Language, Communication and Personality	3	0	0	3	30	20	50	100
5	MC	BCN2005	Universal Human Values-II: Understanding Harmony And Ethical Human Conduct	2	1	0	3	30	20	50	100
6	AUC	BCN2006	Hobbies, Co-Curricular and Extra-Curricular	2	0	0	0	30	20	50	100
7	BSC	BCN2052/1057	Chemistry Lab	0	0	2	1	30	20	50	100
8	PCC	BCN2053	Engineering Graphics Lab	0	0	2	1	30	20	50	100
9	HSC	BCN2054/1058	Life Skills: Entrepreneurship, Language, Communication and Personality Lab	0	0	2	1	30	20	50	100
10	ESC	BCN2059	Design thinking and innovation Lab	0	0	2	1	30	20	50	100
			Total	**16**	**2**	**8**	**20**	**300**	**200**	**500**	**1000**
			Total Up to 2nd Semester				**40**				

III SEM

S No		Course Code	Course Name	L	T	P	C	CA	MTE	ETE	Total

1	PCC	BME3001	Mathematics-III	3	1	0	4	30	20	50	100
2	PCC	BME3002	Engineering Thermodynamics	3	0	0	3	30	20	50	100
3	PCC	BME3003	Fluid Mechanics and Machinery	3	0	0	3	30	20	50	100
4	PCC	BME3004	Mechanics of Deformable Bodies	3	0	0	3	30	20	50	100
5	PCC	BME3005	Primary Manufacturing	3	0	0	3	30	20	50	100
6	PCC	BME3006	Theory of Machines	2	0	0	2	30	20	50	100
7	PCC	BME3052	Engineering Thermodynamics Lab	0	0	2	1	30	20	50	100
8	PCC	BME3053	Fluid Mechanics and Machinery Lab	0	0	2	1	30	20	50	100
9	PCC	BME3054	Mechanics of Deformable Bodies Lab	0	0	2	1	30	20	50	100
10	PCC	BME3055	Primary Manufacturing Lab	0	0	2	1	30	20	50	100
11	PCC	BME3056	Theory of Machines Lab	0	0	2	1	30	20	50	100
12	MC	BCN3007	Humanities-I	2	0	0	2	30	20	50	100
			Total	**19**	**1**	**10**	**25**	**360**	**240**	**600**	**1200**
			Total Up to 3rd Semester	**65**							

IV SEM

S No		Course Code	Course Name	L	T	P	C	CA	MTE	ETE	Total
1	PCC	BME4001	Applied Thermal Engineering	3	1	0	4	30	20	50	100
2	PCC	BME4002	Design of Machine Elements	3	1	0	4	30	20	50	100
3	PCC	BME4003	Measurement & Metrology	3	0	0	3	30	20	50	100
4	PCC	BME4004	Machine Tools and Machining	3	0	0	3	30	20	50	100
5	PCC	BME4005	Electrical Machines and Control Theory	3	0	0	3	30	20	50	100
6	PCC	BME4051	Thermal Engineering Lab	0	0	2	1	30	20	50	100
7	PCC	BME4053	Measurement & Metrology Lab	0	0	2	1	30	20	50	100
8	PCC	BME4056	Machine Tools and Machining Lab	0	0	2	1	30	20	50	100
9	PCC	BME4055	Electrical Machines and Control Theory Lab	0	0	2	1	30	20	50	100
10	PCC	BME4057	Computer Aided Drafting and Modelling Laboratory	0	0	2	2	30	20	50	100
11	MC	BCN4007	Environmental Sciences	3	0	0	0	30	20	50	100
			Total	**18**	**3**	**10**	**23**	**330**	**220**	**550**	**1100**
			Total Up to 4th Semester	**88**							

V SEM

S No		Course Code	Course Name	L	T	P	C	CA	MTE	ETE	Total
1	PCC	BME5001	Heat Transfer	3	1	0	4	30	20	50	100
2	PCC	BMEP301-BMEP320	Profesional Elective -I	3	0	0	3	30	20	50	100
3	PCC	BME5003	Non-Traditional and Computer Aided Manufacturing	3	0	0	3	30	20	50	100
4	PCC	BMEO401-BMEO417	Open Elective-I	3	1	0	4	30	20	50	100
5	PCC	BME5005	Camputer Aided Design	3	1	0	4	30	20	50	100
6	PCC	BME5051	Heat Transfer Lab	0	0	2	1	30	20	50	100
7	PCC	BMEP351-BMEP354	Professional Elective -I Lab	0	0	2	1	30	20	50	100
8	PCC	BME5053	Non-traditional and Computer Aided Manufacturing Lab	0	0	2	1	30	20	50	100
9	PCC	BME5055	Camputer Aided Design Lab	0	0	2	1	30	20	50	100
10	PCC	BME5056	Undergraduate Research in Mechanical Engineering	0	0	2	1	30	20	50	100
11	MC	BCN5007	Essence of Indian Knowledge Tradition	0	0	0	0	30	20	50	100
			Total	**15**	**3**	**10**	**23**	**330**	**220**	**550**	**1100**

			Total Up to 5th Semester	111						
VI SEM										
S No		**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**CA**	**MTE**	**ETE**	**Total**
1	PCC	BMEP301-BMEP320	Profesional Elective- II	3	0	0	3	30	20	50	100
2	OEC	BMEO401-BMEO417	Open Elective-II	3	0	0	3	30	20	50	100
3	OEC	BMEO401-BMEO417	Open Elective-II	3	0	0	3	30	20	50	100
4	PCC	BME6001	Industrial Engineering	3	1	0	4	30	20	50	100
5	PCC	BME6002	Operation Research	3	0	0	3	30	20	50	100
6	BSC	BME6005	Product Design Development	2	0	0	2	30	20	50	100
7	PCC	BME6054	Mini Project	0	0	2	1	30	20	50	100
8	PCC	BME6055	Numerical and Statistical Methods Lab	0	0	2	1	30	20	50	100
				17	**1**	**4**	**20**	**240**	**160**	**400**	**800**
			Total Up to 6th Semester	**131**							
9	PCC	BME6006	**Summer Internship/ Field Work (Minimum 8 weeks)***	**1**							
*** This credit will be reflected in VII semester result.**											
VII SEM										
S No		**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**CA**	**MTE**	**ETE**	**Total**
1	PCC/PEC	BMEP301-BMEP320	Profesional Elective -III	3	0	0	3	30	20	50	100
2	OEC	BMEO401-BMEO417	Open Elective-III	3	0	0	3	30	20	50	100
3	PCC	BME7001	Dynamic System Vibration and Control	3	0	0	3	30	20	50	100
4	PRC	BME7052	Capstone Project Phase-I	0	0	12	6	50	50	100	200
			Total	**9**	**0**	**12**	**15**	**140**	**110**	**250**	**500**
			or								
1	OEC	BMEO401-BMEO417	Open Elective-III	3	0	0	3	30	20	50	100
2	PRC	BME7052	Industrial Project/R&D Project/Industry Internship/Start-up/Externship	0	0	24	12	110	90	200	400
			Total	**3**	**0**	**24**	**15**	**140**	**110**	**250**	**500**
			Total Up to 7th Semester	**146**							
VIII SEM											
S No		**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**CA**	**MTE**	**ETE**	**Total**
1	PEC	BMEP301-BMEP320	Profesional Elective -IV	3	0	0	3	30	20	50	100
2	OEC	BMEO401-BMEO417	Open Elective-IV	3	0	0	3	30	20	50	100
3	PRC	BME8051	Capstone Project Phase-II	0	0	18	9	50	50	100	200
			Total	**6**	**0**	**18**	**15**	**110**	**90**	**200**	**400**
			Total Up to 8th Semester	**161**							

Professional Electives											
S. No.		**Course Code**	**Course Name**	**L**	**T**	**P**	**Credit**	**CA**	**MTE**	**ETE**	**Total**
1	PEC	BMEP301	Introduction to Automobile engineering	3	0	0	3	30	20	50	100

2	PEC	BMEP302	Refrigeration and Air-Conditioning	3	0	0	3	30	20	50	100
3	PEC	BMEP303	Computer Aided Manufacturing	3	0	0	3	30	20	50	100
4	PEC	BMEP304	Heat treatment and processing	3	0	0	3	30	20	50	100
5	PEC	BMEP351	Introduction to Automobile engineering Lab	0	0	2	1	30	20	50	100
6	PEC	BMEP352	Refrigeration and Air-Conditioning Lab	0	0	2	1	30	20	50	100
7	PEC	BMEP353	Computer Aided Manufacturing Lab	0	0	2	1	30	20	50	100
8	PEC	BMEP354	Heat treatment and processing LAb	0	0	2	1	30	20	50	100
9	PEC	BMEP305	Automotive vehicle design	3	0	0	3	30	20	50	100
10	PEC	BMEP306	Fundamentals of HVAC	3	0	0	3	30	20	50	100
11	PEC	BMEP307	Mechatronics	3	0	0	3	30	20	50	100
12	PEC	BMEP308	Materials testing and characterization	3	0	0	3	30	20	50	100
13	PEC	BMEP309	Automotive Electrical and Electronics System	3	0	0	3	30	20	50	100
14	PEC	BMEP310	Off road vehicles	3	0	0	3	30	20	50	100
15	PEC	BMEP311	Electrical design and aspects of HVAC	3	0	0	3	30	20	50	100
16	PEC	BMEP312	Introduction to Robotics	3	0	0	3	30	20	50	100
17	PEC	BMEP313	Power Plant Engineering	3	0	0	3	30	20	50	100
18	PEC	BMEP314	Principles of materials selection	3	0	0	3	30	20	50	100
19	PEC	BMEP315	Power Electronics for Electric Vehicle Application	3	0	0	3	30	20	50	100
20	PEC	BMEP316	Vehicle body engineering	3	0	0	3	30	20	50	100
21	PEC	BMEP317	HVAC design	3	0	0	3	30	20	50	100
22	PEC	BMEP318	Robotic programming and simulation	3	0	0	3	30	20	50	100
23	PEC	BMEP319	Surface engineering	3	0	0	3	30	20	50	100
24	PEC	BMEP320	Vehicle Dynamics	3	0	0	3	30	20	50	100

Open Elective

S. No.		Course Code	Course Name	L	T	P	Credit	CA	MTE	ETE	Total
1	OEC	BMEO401	Measurement and Quality	3	0	0	3	30	20	50	100
2	OEC	BMEO402	Organization Behaviour	3	0	0	3	30	20	50	100
3	OEC	BMEO403	Engineering Materials	3	0	0	3	30	20	50	100
4	OEC	BMEO404	Bio-Materials	3	0	0	3	30	20	50	100
5	OEC	BMEO405	Assurance Value Engineering	3	0	0	3	30	20	50	100
6	OEC	BMEO406	Industrial Trobology	3	0	0	3	30	20	50	100
7	OEC	BMEO407	Total Quality Management	3	0	0	3	30	20	50	100
8	OEC	BMEO408	Non Destrictive Testing	3	0	0	3	30	20	50	100
9	OEC	BMEO409	Biomedical-Instrumentation	3	0	0	3	30	20	50	100
10	OEC	BMEO410	Design Methodology	3	0	0	3	30	20	50	100
11	OEC	BMEO411	Finite Element Analysis	3	0	0	3	30	20	50	100
12	OEC	BMEO412	I.C Engines	3	0	0	3	30	20	50	100
13	OEC	BMEO413	Rehabilitation Engineering	3	0	0	3	30	20	50	100
14	OEC	BMEO414	Reliability and Quality Control	3	0	0	3	30	20	50	100
15	OEC	BMEO415	Six Sigma: Quality and Methodology	3	0	0	3	30	20	50	100
16	OEC	BMEO416	Computer Graphics	3	0	0	3	30	20	50	100
17	OEC	BMEO417	Therapeutic Equipment	3	0	0	3	30	20	50	100

Terminology and Abbreviation					
L-T-P: Lecture-Tutorial-Practical hours per week.					
Credits: Calculated as per AICTE norms (1 credit per lecture/tutorial hour, 0.5 credits per practical hour).					
HSC: Humanities and Social Sciences including Management Courses					
BSC: Basic Science Courses					
ESC: Engineering Science Courses					
Profe					
PEC: Professional Elective Courses					
OEC: Open Elective Courses					
PRC: Project Work, Seminar, Internship Courses					
MC: Mandatory Courses					
AUC: Audit Cources					
BMEP: Computer Science Specialization Elective					
BMEP: Computer Science Professional Elective					
BMEO: Computer Science Open Elective					

MOOC: As per page no 191 of AICTE Model Curriculum for UG Degree Course 2022

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

(vide U.P. Act No.1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))

Ref. No. :R.U./Reg./2021/ 10 Dated : 06.01.2021

To,

1. All Deans/Except (Medical, Dental, Nursing, Paramedical and Pharma)
2. C.O.E.

Sub: Integration of MOOCS in Rama University's Curriculum.

This is to bring it to your kind attention that Rama University is implementing MOOCs which is a web-assisted or blended learning format as per UGC/AICTE guidelines. These regulations will be made applicable from the academic session 2019-20 onwards.

All the faculties (Except Medical, Dental, Nursing , Paramedical and Pharma) of Rama University are hereby notified that MOOCs courses will be integrated into all the course programs of Rama University and will have a credit score as specified under the UGC guidelines. Please refer below for the details:

UG Program	Credit score
2 Years	8 Credits
3 Years	12 Credits
4 Years	20 Credits
5 Years	25 Credits

MOOCs Program Duration	Credit Index
4 Weeks	2
8 Weeks	3
12 Weeks	4

Please note all the faculties have to include the MOOCS courses into their curriculum structure. For ease of understanding, you may refer the AICTE B.Tech Model Curriculum structure.

Letter No - REGD. No – D.L. 33004/99 Date: 20 July 2016 refers following Para;

" The parent Institution shall, incorporate the marks/grade obtained by the student, as communicated by the Host Institution through the PI of the SWAYAM course in the marks sheet of the student that count for final award of the degree/diploma by the University with the proviso that the programs in which Lab/practical Component is involved, the parent institution will evaluate the students for the practical/Lab component and accordingly incorporate these marks/grade in the overall marks/grade."

(Registrar)

कुलसचिव
रामा विश्वविद्यालय
उ0प्र0, कानपुर 209217

Copy to:-

1- Secretary to Hon'ble Chancellor.
2- Secretary to Hon'ble Vice-Chancellor.
3- Deputy Registrar/A.R. / C.E.
4- Guard File