BMS Institute of Technology and Management

(Autonomous Institution, Affiliated to VTU)

Post Box No. 6443, Avalahalli, Doddaballapura Main Road,
Yelahanka, Bengaluru-560 064.

Bachelor of Engineering (BE)
Department of Mechanical Engineering

V and VI Semester Scheme and Syllabus

(Approved in the BoS meeting held on 22.05.2023)

2021 Scheme - Autonomous

Vision and Mission of the Department

Vision

- To develop technically competent Mechanical Engineering professionals for the benefit of the society

Mission

- Impart quality education in Mechanical Engineering and allied areas by state-of- the- art- infrastructure and dedicated faculty.
- Provide conducive environment for both students and faculty to pursue higher education & research and to work ethically for the benefit of society.

Program Educational Objectives (PEOs)

1. Be successful professionals in the field of Mechanical Engineering and allied areas.
2. Exhibit skills to work effectively and ethically in multiple domains of engineering as part of a team.
3. Excel in higher studies, research and adapt in a world of constantly developing technology.

Program Specific Outcomes (PSOs)

1. Design, Analyse and fabricate the mechanisms.
2. Analyse the fluid and thermal aspects of different mechanical systems and components.
3. Develop materials and components through different manufacturing methods with managerial skills.

Scheme of V Semester

BMS Institute of Technology and Management
(Autonomous Institute affiliated to VTU)
Scheme of Teaching and Examination: Effective from AY2021–22
Choice Based Credit System (CBCS)

UG PROGRAM: Mechanical Engineering (ME) — **Semester: V**

Sl. No	Course Category	Course Code	Course Title	Teaching Department	Teaching Hours /Week				Credits	Examination			
					L	T	P	PW		Duration in Hours	CIE Marks	SEE Marks	Total Marks
1	HS	21HSS51	Management and Entrepreneurship	ME	3	0	0	0	3	3	50	50	100
2	AEC	21AEC52	Cyber and Intellectual Property law	ME	0	2	0	0	1	1	50	50	100
3	INT	21INT53	Innovation / Entrepreneurship / Societal Internship	ME	0	0	0	6	3	-	100	-	100
4	PE	21ME54X	Professional Elective I	ME	3	0	0	0	3	3	50	50	100
5	PC	21ME55	Applied Thermodynamics and Heat Transfer	ME	2	2	0	0	3	3	50	50	100
6	PC	21ME56	Design of Machine Elements	ME	2	2	0	0	3	3	50	50	100
7	PC	21ME57	Theory of Machines	ME	2	2	0	0	3	3	50	50	100
8	PC	21MEL58A	Energy Conversion Lab	ME	0	0	2	0	1	3	50	50	100
9	PC	21MEL58B	Heat Transfer Lab	ME	0	0	2	0	1	3	50	50	100
10	PC	21MEL58C	Design Lab	ME	0	0	2	0	1	3	50	50	100
TOTAL					12	8	6	6	**22**				

Professional Elective-Group I	
Course Code	**Course Title**
21ME541	Advanced Materials
21ME542	Dynamics of Energy Conversion
21ME543	Micro and Nano Machining
21ME544	Human Resource Management
21ME545	Mechatronics

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(An Autonomous Institution affiliated to VTU, Belagavi)
Yelahanka, Bengaluru-560064

Date: 14.06.2023

CIE and SEE Pattern for 2021 Scheme
(Applicable from the AY 2021-22 onwards)

Important Note:

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Examinations (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for SEE minimum passing mark is 35% of the maximum marks (18 marks out of 50). The student is declared as a pass in the course if he / she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

4 CREDIT and 3 CREDIT COURSES

I. CONTINUOUS INTERNAL EVALUATION (CIE): 50 MARKS

- Internal Assessment (IA) Tests: 3 IAs to be conducted for 40 Marks (90 minutes each). Total of 3 tests will be 120 and the same can be scale down to **60 marks.**
- Alternate Assignment Tool (AAT): 2 AATs each of 10 marks, total **20 marks.**
- Assignments: 2 assignments of each 10 marks, total **20 marks**.
- CIE marks = 60 + 20 + 20 = 100 and same can be scale down to **50 marks.**
- Student has to score minimum of 20 marks (40%).

II. SEMESTER END EXAMINATIONS (SEE): 50 MARKS

SEE is conducted for 100 Marks (3 hours).

Question Paper Pattern:

Part - A: Comprises 20 objective type questions carrying 1 Mark each with a total 20 Marks.

Part - B: There will be **5 modules**. Each module will have **TWO questions carrying 16 marks** each. There will be a maximum of three sub section for each question. **Student has to answer any ONE full question from each module.**

SEE Marks = 20 + 80 = 100 marks and can be scale down to 50 marks.

2 CREDIT COURSES

I. CONTINUOUS INTERNAL EVALUATION (CIE): 50 MARKS

- Internal Assessment (IA) Tests: 3 IAs of MCQ type to be conducted for 40 Marks (60 minutes each). Total of 3 tests will be 120 and the same can be scale down to **60 marks.**
- Alternate Assignment Tool (AAT): 2 AATs each of 10 marks, total **20 marks**.
- Assignments: 2 assignments of each 10marks, total **20 marks.**
- CIE marks = 60 + 20 + 20 = 100 and same can be scale down to **50 marks.**
- Student has to score minimum of 20 marks (40%).

II. SEMESTER END EXAMINATIONS (SEE): 50 MARKS

SEE is conducted for 100 Marks (2 hours).

Question Paper Pattern:

- The pattern of the question paper is MCQ.
- SEE question paper will be set for 100 questions each of 01 marks. The same is scale down to 50 marks.

1 CREDIT COURSES

I. CONTINUOUS INTERNAL EVALUATION (CIE): 50 MARKS

- Internal Assessment (IA) Tests: 3 IAs of MCQ type to be conducted for 40 Marks (60 minutes each). Total of 3 tests will be 120 and the same can be scale down to **60 marks.**
- Alternate Assignment Tool (AAT): 2 AATs each of 10 marks, total **20 marks.**
- Assignments: 2 assignments of each 10marks, total **20 marks.**
- CIE marks = 60 + 20 + 20 = 100 and same can be scale down to **50 marks.**
- Student has to score minimum of 20 marks (40%).

II. SEMESTER END EXAMINATIONS (SEE): 50 MARKS

SEE is conducted for 50 Marks (1 hours).

Question Paper Pattern:

- The pattern of the question paper is MCQ.
- SEE question paper will be set for 50 questions each of 01marks. The same is scale down to 50 marks.

1 CREDIT LABORATORY COURSES

I. CONTINUOUS INTERNAL EVALUATION (CIE): 50 MARKS

- Cumulative Assessment (CA) of each experiment is 20 Marks (Conduction 10 marks + Records 5 marks +Viva 5marks). The average of all the experiments to be taken for **20 marks.**
- Open Ended Experiments (OE) **10 marks.**
- 2 IAs Test to be conducted for 100 marks. General rubrics suggested for SEE are: Writeup 20 marks, Conduction of the experiments, calculations, graphs, results, etc.,: 60 marks and Viva: 20 marks. The average of 2 IA marks is scale down to **20 marks**.
- CIE marks =20 (CA) +10 (OE) + 20 (IA test) = 50 marks.
- Student has to score minimum of 20 marks (40%).

II. SEMESTER END EXAMINATIONS (SEE): 50 MARKS

SEE is conducted for 100 Marks and scale down to 50 Marks.

Examinations to be conducted jointly by Two examiners. All the experiments are to be included for practical examination. General rubrics suggested for SEE are: Writeup 20 marks, Conduction of the experiments, calculations, graphs, results, etc.,: 60 marks and Viva: 20 marks.

CoE 16/06/2023 Dean AA 16/06/2023 Principal 19/6/23

V Semester Syllabus

B.E. MECHANICAL ENGINEERING
Choice Based Credit System (CBCS)
SEMESTER -V

Management and Entrepreneurship (3:0:0)3
(Effective from the academic year 2021-22)

Course Code	**21HSS51**	CIE Marks	50
Teaching Hours/Week (L: T:P)	**3:0:0**	SEE Marks	50
Total Number of Contact Hours	**40**	Exam Hours	03

Course objectives:
This course will enable students to:

1. Define the strategic, tactical, and operational roles and functions of management.
2. Use critical thinking to formulate and execute managerial entrepreneurial strategies, plans, and procedures.
3. Understand the Ideation Process, creation of Business Model, Feasibility Study, and sources of fundi

Preamble: Management and Entrepreneurship course will provide with the skills required to plan, set up and run your own business. It is designed to understand the key concepts such as managing people, operations, decision-making marketing, finance, and social responsibilities.

Module –1

Management: Significance and Scope of Management, Importance of the management and entrepreneurship in Economic growth of Nation, Impact of the entrepreneurship on Societal Problems for Sustainable Solutions. Management in the perspective of National Economy, Career, Innovations, and trends. Management functions, Levels of management, Roles of manager, Managerial skills, Management & Administration.

Planning: Importance, Types, Steps and Limitations of Planning; Decision Making types and Steps in Decision Making.

(8 Hours)

Self-Study Component: Case studies on managerial roles and responsibilities

Module –2

Organizing and Staffing: Organization-Characteristics, Process of Organizing, Principles of Organizing, Span of Management, Departmentalization.
Committees: Types of Committees; Centralization Vs Decentralization of Authority, Responsibility. Staffing: Importance, Recruitment and Selection Process.

Directing and Controlling: Requirements of Effective Direction.
Motivation: Nature of Motivation, **Motivation Theories** (Maslow's Need-Hierarchy Theory and Herzberg's Two Factor Theory). **Communication:** Importance and Purposes of Communication. **Leadership:** Characteristics, Behavioral Approach of Leadership. **Coordination:** Types, Techniques of Coordination; **Controlling:** Need for Control System, Benefits of Control, Essentials of Effective Control System, and Steps in Control Process.

(8 Hours)

Self-Study Component: Controlling techniques

Module –3

Entrepreneurship: Importance of Entrepreneurship, concepts of Entrepreneurship, Characteristics of successful Entrepreneur, Classification of Entrepreneurs, Myths of Entrepreneurship, Entrepreneurial Development models, Entrepreneurial development cycle, Problems faced by Entrepreneurs and capacity building for Entrepreneurship. Theories of Entrepreneurship.

(8 Hours)

Self-Study Component: Sources of funding, Working capital management and Taxation benefits

Module –4

Entrepreneurial Project Development: Idea Generation and Feasibility Analysis-Idea Generation; Creativity and Innovation; Identification of Business Opportunities; Market Entry Strategies; Marketing Feasibility; Financial Feasibilities; Political Feasibilities; Economic Feasibility; Social and Legal Feasibilities; Technical Feasibilities; Managerial Feasibility, Location and Other Utilities Feasibilities.

(8 Hours)

Self-Study Component: Case studies on entrepreneurial abilities

Module –5

Social Responsibilities of Business: social responsibility, social responsibilities of business towards different groups, social audit, business ethics and corporate governance., Corporate governance in India

(8 Hours)

Self-Study Component: Case studies on social responsibility of an entrepreneur/manager

Course out comes:

The students will be able to:

CO1: Comprehend the fundamental concepts of Management and Entrepreneurship and opportunities in order to set up a business.
CO2: Categories the functions of Managers, Entrepreneurs, and their social responsibilities.
CO3: Analyze the business environment components in developing a business plan.
CO4: Individually and in teams identify, concept utilize, and develop solutions for successful entrepreneurial management.

Textbooks:

1. P. C. Tripathi., P. N. Reddy., "Principles of Management." 6th Edition, McGraw-Hill Education, 2017.
2. Dr. Vasant Desai, "Dynamics of Entrepreneurial Development and Management", 6th Edition, Himalayan Publishing House, 2019.

References:

1. Poornima.M. Charantimath., "Entrepreneurship Development Small Business Enterprises", Pearson Education,2008.
2. Robert. D. Hisrich.,Mathew.J.,Manimala.,Michael.P.Peters.,Dean.A.,Shepherd, "Entrepreneurship", 8th Edition, Tata Mc Graw Hill Publishing Co. ltd, 2012.
3. Harold Koontz, Heinz Weihrich,"Essentials of Management: An International ,Innovation And Leadership perspective",10th Edition, Mc Graw Hill Education,2016.

B.E. MECHANICAL ENGINEERING
Choice Based Credit System (CBCS)
SEMESTER -V

Cyber and Intellectual Property Law (0:2:0)1
(Common to all Branches)
(Effective from the academic year 2021-22)

Course Code	**21AEC52**	CIE Marks	50
Teaching Hours/Week (L: T:P)	**0:2:0**	SEE Marks	50
Total Number of Contact Hours	**15**	Exam Hours	01

Course Objectives:

This course will enable students to:

1. Understand the concept of IP, copyright, patent and its protection.
2. Explain the scope of trademarks, industrial and IC layout design.
3. Enhance their knowledge on IP management and related agreements.
4. Understand overview of Cyber law and cyber policies.
5. Identify different types of cybercrime and security measures.

Preamble: Importance of intellectual property (IP), IP Law requirement of an information security policy, cyber law, and information technology act.

Module – 1

Introduction to Intellectual Properties (IP): Various forms of IP, Intellectual property verses physical property, importance of intellectual property.
Copyright: Different classes of copyright work, ownership of copyright, term of copyright, infringement of copyright.
Patent: Fundamentals of patent, condition for grant of patent, inventions those are not patentable, right of patentee, transfer of patent right, Infringement of patent right, challenges in patents.

(03 Hours)

Self-Study Component: Infringement of copyright.

Module – 2

Trademarks: Introduction to trademark, developing trademark, term of trademark, collective marks, certification trademarks, Infringement of trademark.
Integrated Circuit Layout Design: Introduction to Semi-Conductor Integrated Circuits Layout, The Semi-Conductor Integrated Circuits Layout Design (SICLD) Act, 2000.
Industrial Design: Design registration, Industrial design act 2000.

(03 Hours)

Self-Study Component: Lay out design of integrated circuit

Module – 3

Creating IP: Need for creating IP, Process of development of IP and knowledge.
Trade-Related aspects of IPR (TRIPS): Need and objectives, Agreement on trip, scheme of agreements. WIPO: Objectives, functions, memberships.
Treaties: Patent cooperation Treaty (PCT)**:** filing patent under PCT, Different stages and procedure in PCT filing. Paris Convention Treaty**:** filing patent under Paris convention treaty, Different procedure stages.
IP Management: Defining IP management, need for and importance of IP management, Undertaking IP intelligence, acquisition of IP, managing IP portfolio, commercialisation of IP, protecting IP.

(03 Hours)

Self-study component: Commercialisation of IP.

Module – 4

Cyber Law: introduction to Indian cyber law, need for cyber law, jurisprudence of cyber law, importance of cyber law.
IT Act: Objective and scope of The Indian Information Technology Act 2000.

Cyber Crimes: What constitute cybercrime, Important cybercrimes.
C**yber policies:** Need for an information security policy, information security standard-ISO, introduction to various security policies.
Case study on cybercrime.

(03 Hours)

Self-Study Component: Information security standard –ISO.

Module – 5

Phishing: Spear phishing, protecting from phishing attack, cyber stalking, how to prevent cyber stalking.
Hacking: types, Protection of computers from intrusion and types, different types of hackers and their operation.
Data theft: IT act related to data theft, Spam E-mail, IT act related to spam mail, Software piracy, types, legal penalties, Identity theft, prevention practice.
Electronic and digital signature: Role of electronic signature, types of electronic signature, guidelines for electronic signature. Creation of digital signature.

(03 Hours)

Self-Study Component: Digital signature in India.

Course Outcomes:
The students will be able to:
CO1: Describe the concept of copyright and patent and its protection.
CO2: Explain the scope of trademarks, industrial and IC layout design.
CO3 Describe Intellectual property management and related agreements.
CO4: Understand overview of Cyber law and cyber policies.
CO5: Discuss different types of cybercrime and security measures.

Textbooks:

1. V Appukutty, "Cyber Crime & Law", Coral Publishers, 2022.
2. Surya Prakash Tripati, Ritendra Goel, Praveen Kumar Shukla, "Introduction to Information Security and Cyber Laws", Dream Tech Press, 2021.
3. Neeraj Pandey, KhushdeepDharni, "Intellectual Property Rights", PHI Learning, 2014.

References:

1. Prabhuddha Ganguli, "Intellectual Property Rights", Tata Mc-Graw –Hill, 2017.
2. S R Myneni, "Patent Right Creation and Registration", Asia Law House, 2017.
3. Marjie T. Britz, "Computer Forensics and Cyber Crime: An Introduction", Pearson, 3rd Edition, 2004.
4. Bill Nelson, Amelia Phillips, Christopher Steuart, "Guide to Computer Forensics and Investigations", Cengage Learning, 4thEdition, 2010

B.E. MECHANICAL ENGINEERING
Choice Based Credit System (CBCS)
SEMESTER -V

Innovation / Entrepreneurship/ Societal Internship (0:0:0:3) 3
(Common to all Branches)
(Effective from the academic year 2021-22)

Course Code	**21INT53**	CIE Marks	100
Teaching Hours/Week (L:T:P:PW)	**0:0:0:6**	SEE Marks	--
Total Number of Contact Hours	**4 weeks**	Exam Hours	--

Course Outcomes: Students will be able to

1. Acquire academic/ career/ personal overall skill/ knowledge development.
2. Perceive ample opportunities for professional growth and achievement with relevance to society and environment.
3. Expose to real job world environment and gain practical knowledge with experience.
4. Build leadership qualities, teamwork, collaborations, cooperation, and facility in using virtual workspace.
5. Intensify creativity, artistry, curiosity, imagination, innovation, incubation, entrepreneurial skills and personal expression.
6. Write report on the work/ project carried out with presentation.

During the intervening period of IV and V semesters, students shall be ready for industrial experience. Therefore, they shall choose to undergo Internship involving Innovation / Entrepreneurship/Societal related activities. Students may choose to work on innovation or entrepreneurial activities, or both resulting in start-up or undergo internship with industry/ NGO's/ Government organizations/ Micro/ Small/Medium enterprises to make themselves ready for the industry. In case students want to undergo internship at his/her family business, he /she shall will be permitted provided, a declaration by a parent is submitted directly to the Principal of the institution.

Innovation
Innovation refers to a new or improved product or process or a combination thereof that differs marginally or significantly from the unit's previous product. An innovation centre is a place where students are encouraged to implement the innovative ideas formed through imagination, brainstorming sessions, design thinking and associated activities to bring them to reality. It is a place, where creative minds are shaped.

Entrepreneurship
Entrepreneurship refers to setting up a new business or businesses, taking on financial risks in the hope of profit. It involves investment to undertake production along with arranging inputs like land, labour, material and capital, introducing new techniques and products, identifying new sources for the enterprise, etc.

Incubation Centre
An organized unit designed for innovation as well as to accelerate the growth and success of new entrepreneurial companies through mentorship and an array of business support resources and services that could include physical space, capital, coaching, common services, and networking connections.

Startup
An entity that develops a business model based on either product innovation or service innovation and makes it scalable, replicable and self-reliant.

Societal (Social) related activities

Short term internship at villages, slums or urban areas can be under social internship. The internship will be more fruitful, if students work in teams. The teams can select one or more fields to do their best in the field of agriculture, watershed management, wastelands development, non-conventional energy, low cost housing, sanitation, nutrition and personal hygiene, schemes for skill development, income generation, blood bank, government scheme such as Swachch Bharat, Accessible India, Digital India, Beti Bachao and Beti Padhao, Environment and Energy Conservation and Education, legal aid, consumer protection and allied field including Indian Red Cross Society, National CadetCorps, Bharat Scouts and Guides.

Places for Innovation/Entrepreneurial Activities

Students shall carryout Innovation or Entrepreneurial activities or both at the Incubation Centre and Entrepreneurship Cell of the parent institution or elsewhere such as ATAL Incubation Centres [A flagship of Atal Innovation Mission (AIM), NITI Aayog for promoting the culture of innovation and entrepreneurship in India], institutes of national importance, public sector units, IT companies, government organizations, and non-governmental organizations, industries including MSME, etc. Institutes, should deter students to opt for internships at places established for commercial benefits.

MECHANICAL ENGINEERING
Choice Based Credit System (CBCS)
SEMESTER - V

Advanced Materials (3:0:0) 3
(Effective from the academic year 2020-21)

Course Code	**21MEC541**	CIE Marks	50
Teaching Hours/Week (L:T:P)	**3:0:0**	SEE Marks	50
Total Number of Contact Hours	**40**	Exam Hours	03

Course objectives:

This course will enable students to:

1. To understand the mechanics of different materials.
2. Topics to explore anisotropic and constituent properties of functional materials.
3. To understand the need of different types of advanced materials for today's growing world.
4. The relate the concepts of nano materials towards applications.
5. To map the applications for all the types of advanced materials.
6.

Preamble:

Advanced materials are such materials that help us to drive technological innovation and optimise the cost and efficiency of existing products, i.e., traditional materials. Advanced materials affect all industries, not only in the creation of new products but can optimize the performance of existing products and materials.

Module – 1

Metals and ceramics:

stainless steels, cobalt based alloys, titanium based alloys, characteristics and processing of bio ceramics, nearly inert crystalline ceramics, porous ceramics, bioactive glasses and glass ceramics, calcium phosphate ceramics, calcium phosphate coatings, resorbable calcium phosphates, clinical applications of hydroxyapatite. Pyrolytic carbon

(8 Hours)

Self-study topics: Influence of glass on environment.

Module – 2

Polymers.

Relevant international standards: ISO, FDA and ASTM Polymers in drug delivery : Introduction to polymeric drug delivery systems, Targeted drug delivery. Passive or active targeting, targeting tumor cells, polymer-protein conjugates, polymer drug-conjugates. Pharmacokinetics. Application of hydrogels in controlled drug delivery system

(8 Hours)

Self study topics: Progressive drug delivery system for patients

Module – 3

Biomaterials:

Introduction to classes of materials used in medical applications: Metals, polymers, ceramics, bioresorbable and biodegradable materials, coatings, medical fibers, non fouling surfaces. Testing of biomaterials: In Vitro and in vivo assessment of tissue compatibility. Testing of bloodmaterials interactions. ISO standards for testing of blood compatibility and tissue compatibility. Degradation of materials in the biological environment

(9 Hours)

Self study topics: Effects of the Biological environment on metals

Module – 4

Smart biomaterials:
Stimuli responsive polymers (pH, temperature, light, magnetic and biomolecules) and their applications as biomaterials. Stimuli responsive hydrogels.

(7 Hours)

Self-study topics: Study of hydrogels in knee joints

Module – 5

Nano biomaterials:
Interaction of bio-molecules and nano particle surfaces. Biocompatible nanomaterials, Nanogels and microgels: preparation methods, characterization and applications.

(8 Hours)

Self-study topics: Characterization of nanomaterials using **Transmission Electron Microscopy** (TEM)

Course outcomes: The students will be able to:
CO1: Understand materials Classification and applications.
CO2: Analyze the functions of materials for suitable applications.
CO3: Evaluate the properties of metals, Ceramics, polymers biomaterials and Nano-biomaterials.
CO4: Discuss on environmental and sustainable concerns with respect to compatibility of advanced materials.

Textbooks:

1. B. Ratner, A. Hoffman, F. Schoen, J Lemons, Biomaterials Science: An introduction to materials in Medicine. 2nd edition, Academic Press, 2004.
2. S. Dumitriu, 2nd edition, Polymeric Biomaterials. Marcel Dekker, 2002
3. C. T. Laurencin, L. S. Nair, Nanotechnology and Tissue Engineering, The Scaffol, CRC Press, 2008

References:

1. S. Ramakrishna, T. S. Sampath Kumar, Biomaterials: A nano approach.CRC press, 2010
2. I Galaev, Bo Mattiasson, Smart Polymers: Applications in Biotechnology and Biomedicine, 2nd Edition, CRC Press,2007
3. S. Li, A. Tiwari, M. Prabaharan and S. Aryal, Smart Polymer Materials for Biomedical Applications (Materials Science and Technologies), Nova Science Publishers Inc, 2010
4. M. De Villiers, P Aramwit and G S. Kwon, Nanotechnology in drug delivery. Springer, 2009.
5. A Kirkland and J. Hutchison, Nano characterization, RSC publishers, 2007.

B. E. MECHANICAL ENGINEERING
Choice Based Credit System (CBCS)
SEMESTER - V

Dynamics of Energy Conversion (3:0:0) 3
(Effective from the academic year 2021-22)

Course Code	**21ME542**	CIE Marks	50
Teaching Hours/Week (L: T:P)	**3:0:0**	SEE Marks	50
Total Number of lecture hours	**40**	Exam Hours	03

Course Objectives:

This course will enable students to:
1. Understand typical design of SI engine, CI engine, Turbo machines and their working principle, application, thermodynamics process involved.
2. Study the conversion of fluid energy to mechanical energy in Turbo machine with utilization factor and degree of reaction.
3. analyses various designs of steam turbine and their working principle.
4. Study the various designs of hydraulic turbine based on the working principle.

Preamble: Introduction on importance and impact of types of fuels, engine operations and blade angles, on power generation and power absorption in various machines.

Module-1

Carburetion and combustion process in S.I. Engines: Mixture requirements in S.I. engine. Simple carburetor and its limitations. Knock free and knocking combustion- theories of combustion process in S.I. engines. Effect of engine performance. Effect of operating variables on knocking. Knock rating of fuels-octane number. Anti knock agents- ignition-post ignition.

(08 Hours)

Self-Study: Working of Electric Vehicle.

Module-2

Combustion in C.I. Engines: Ricardo's three stages of combustion process in C.I engines. Delay period & factor affecting delay period. Diesel knock-methods of controlling diesel knock. Knock rating of diesel fuels.

(08 Hours)

Self-Study: Working of Hybrid Electric Vehicle.

Module-3

Energy exchange in Turbo machines: Euler's turbine equation, Alternate form of Euler's turbine equation, Velocity triangles for different values of degree of reaction, Components of energy transfer, Degree of Reaction, utilization factor, Relation between degree of reaction and Utilization factor, Problems.

General Analysis of Turbo machines: Expression for degree of reaction, velocity triangles, Effect of blade discharge angle on energy transfer and degree of reaction, Effect of blade discharge angle on performance, Numerical Problems.

(08 Hours)

Self-Study: Classification of turbo machines.

Module-4

Steam Turbines: Classification, Single stage impulse turbine, condition for maximum blade efficiency, stage efficiency, Need and methods of compounding, multi-stage impulse turbine, expression for maximum utilization factor, Numerical Problems.

Reaction turbine – Parsons's turbine, condition for maximum utilization factor, reaction staging. Numerical Problems

(08 hours)

Self-Study: Steam power plants in India

Module-5

Hydraulic Turbines: Classification, various efficiencies.

Pelton Wheel – Principle of working, velocity triangles, design parameters, maximum efficiency, and numerical problems.

Francis's turbine – Principle of working, velocity triangles, design parameters, and numerical problems

Kaplan and Propeller turbines - Principle of working, velocity triangles, design parameters and Numerical Problems. Theory and types of Draft tubes

(08 Hours)

Self-Study: Hydraulic plants in India

Course Outcomes:

The student will be able to:

CO1: Summarize typical design of turbomachines, IC engines and compare turbomachines using dimensional analysis.

CO2: Apply Eulers turbine equation for various turbomachines and combustion concept in IC engines.

CO3: Analyze the energy transfer in engines, hydraulic and steam turbines on a 1D bases with their use of velocity triangles and conduction of flip class/quiz/model demonstration/virtual lab experiments

CO4: Evaluate various type of steam and hydraulic turbine.

Textbooks:

1. M.L. Mathur and R.P. Sharma, A Course in I.C. Engines, Dhanpat Rai & Co. Pvt. Ltd, 2001.
2. V. Kadambiand Manohar Prasad, An Introduction to Energy Conversion, McGraw–Hill,Volume 2, 2002.

References:

1. Shankar Nag G L, Keerthi Kumar N, Turbomachines, Cengage Publications, 1st Edition, 2019.
2. D. G. Shepherd, Principals of Turbo machines, The Macmillan Company, 4th Edition, 1964.
3. S. M. Yahya, Turbines, Compressors & Fan, Tata McGraw Hill Co. Ltd, 2nd Edition, 2002

B.E MECHANICAL ENIGINEERING

Choice Based Credit System (CBCS)

SEMESTER - V

Micro and Nano Machining (3:0:0) 3

(Effective from the academic year 2021-2022)

Course Code	**21ME543**	CIE Marks	50
Teaching Hours/Week (L:T:P)	**3:0:0**	SEE Marks	50
Total Number of Lecture Hours	**40**	Exam Hours	03

Course Objectives:

This course will enable students to:

1. To learn various concepts related to modern machining processes & their applications.
2. To appreciate the differences between conventional and non-conventional machining processes.
3. To acquire a functional understanding of non-traditional manufacturing equipment.
4. To know about various process parameters and their influence on performance and their applications.
5. To impart knowledge on various types of energy involved in non-traditional machining processes.

Preamble:

Non-traditional machining refers to a group of manufacturing processes that do not rely on traditional methods such as cutting, drilling, or milling. These processes often utilize advanced technologies and materials to achieve high precision and accuracy in the production of complex parts and components.

Module – 1

Introduction: Technological and commercial need, classification, performance constraints, selection of NTM, hybrid processes, Current research in NTM (Only discussion), advantages, limitations and applications.

(4 hours)

Self-Study Component: History of machining

Module – 2

Ultrasonic Machining (USM): Ultrasonic machining system, mechanics of cutting, process parameters, analysis, capability, grain growing model, grain hammering model, advantages, limitations and applications, problems.

(6 hours)

Abrasive Jet Machining (AJM): Introduction, Equipment and process of material removal, process variables: carrier gas type of abrasive, work material, stand-off distance (SOD). Process characteristics-Material removal rate, Nozzle wear, accuracy & surface finish.
Applications, advantages & limitations of AJM, problems.

Water Jet Machining (WJM): Equipment & process, Operation, applications, advantages and limitations of WJM.

(8 hours)

Self-Study Component: Abrasive water jet machining process.

Module – 3

Electro Chemical Machining: Working principle, components and functions, effect of process parameters, material removal rate and mechanism, limitations and applications, problems.

Chemical Machining (CHM): Elements of the process: Resists (maskants), Etchants. Types of chemical machining process chemical blanking process, chemical milling process. Process characteristics of CHM: material removal rate, accuracy, surface finish, advantages, limitations and applications of chemical machining process.

(7 hours)

Self-study component: Electrochemical grinding process.

Module – 4

Electrical Discharge Machining (EDM): Working principle, process parameters, process capabilities, components of system and its functions, flushing techniques, effect of various parameters on material removal rate, application and limitations, electrical discharge wire cutting, wire EDM machine, application, and limitations.

Plasma Arc Machining (PAM): Working principle, process parameters, process capabilities, components of system and its functions, various plasma arc torches, process capabilities, comparison with oxy fuel cutting, application and limitations.

(07 hours)

Self-study component: Ion beam machining

Module – 5

Laser Beam Machining (LBM): Types of lasers, process characteristics, working principle, process parameters, process capabilities, components of system and its functions, limitations, application in drilling, cutting, marking and miscellaneous applications.

Electron Beam Machining (EBM): Working principle, process parameters, process capabilities, components of system and its functions, application, and limitations.
Summary of NTM processes.

(08 hours)

Self-study component: Laser-Assisted ECM

Course outcomes:

The students will be able to:

CO 1: Categorize the various Non-Traditional Machining process to machine modern materials.
CO 2: Determine an appropriate Non-Traditional Machining technique to machine the given material.
CO 3: Identify the Process parameters affecting of various Non- Traditional Machines processes.
CO 4: Interpret the given Non-Traditional Machining processes case study material.

Textbooks:

1. Gary F Benedict., "Non-Traditional Manufacturing Processes", Taylor & Francis, 2019.
2. Pandey Shan, "Modern machining process", Tata McGraw Hill, 2013.

References:

1. HMT, "Production Technology", Tata McGraw Hill, 2017.
2. M.Adithan, "Unconventional Machining Processes", Atlantic publisher, 2014.

B.E. MECHANICAL ENGINEERING
Choice Based Credit System (CBCS)
SEMESTER - V

Human Resource Management (3:0:0) 3
(Effective from the academic year 2021-22)

Course Code	**21ME544**	CIE Marks	50
Teaching Hours/Week (L: T:P)	**3:0:0**	SEE Marks	50
Total Number of Contact Hours	**40**	Exam Hours	03

Course objectives:

This course will enable students to:

1. To develop meaningful understanding of Human Resource (HR) theory, functions, and practices.
2. To apply HR Concepts and skills across various types of organizations.

Preamble:

Introduction to import acne human resources forth stability of a country, development, and sustenance of world economy.

Module – 1

Human resource management: Introduction, meaning, nature, scope of HRM. Importance and evolution of concept of HRM. Major functions of HRM, principles of HRM, organization of personnel department, role of HR manager.

Job analysis: Meaning, process of job analysis, methods of collecting job analysis data, job description and specification, role analysis.

(09 Hours)

Self-Study Component: Definition of management, classification of management, hierarchy in management

Module – 2

Human Resource Planning: Objectives, importance, and process of effective HRP.

Recruitment: Definition, constraints and challenges, sources and methods of recruitment, new approaches to recruitment.

Selection: Definition and process of selection.

(07 Hours)

Self-Study Component: Interact with placement and training cell and understand HR practices of a company

Module – 3

Placement: Meaning, induction/orientation, internal mobility, transfer, promotion, demotion, and employee separation.

Training and development: Training/ development, Training/ education, systematic approach to training, training methods, executive development, methods and development of management development, career, and succession planning.

(08 Hours)

Self-Study Component: Interact with HR of a company regarding transfers and promotions.

Module – 4

Performance appraisal: Concept of Performance appraisal, the Performance appraisal process, methods of Performance appraisal, essential characteristics of an effective appraisal system.

Compensation: Objectives of compensation planning, job evaluation, compensation pay structure in India, wage and salary administration, factors influencing compensation levels, executive compensation.

(07 Hours)

Self-Study Component: Appraisal methods and forms of various types of industries.

Module – 5

Employee welfare: Introduction, types of welfare, facilities and statutory provisions. Labor laws.

Employee grievances: Employee grievance procedure, grievances management in Indian industry.

Discipline: Meaning, approaches to discipline, essential of a good disciplinary system, managing difficult employees. Summary of the course

(09 Hours)

Self-Study Component: Statutory rules of state government, central government about labor / employee welfare schemes

Course outcomes:

The students will be able to:

CO 1: Understand the importance, functions and principles of human resources management and the process of job analysis.
CO 2: Summarize the objectives of human resource planning, recruitment, and selection.
CO 3: Understand the process involved in Placement, Training, and development activities.
CO 4: Understand the characteristics of an effective appraisal system and compensation Planning.
CO 5: Understand the issues related to employee welfare, grievances, and discipline.

Textbooks:

1. Cynthia .D. Fisher, "Human Resource Management", AIPD, Chennai, 3rd Edition.
2. Aswathappa K,"HumanResourceManagement"HPH,3rd Edition,2009.

References:

1. John.M. Ivancevich," Human Resource Management GrawHill, 10th Edition.
2. Srinivas.R.Kandulla,"HumanResourceManagementinPractice",PHI,2nd Edition, 2010.
3. Luis.R.Gomez. Mejia, David B. Balkin, RobertLCaedy, "Human Resource Management", PHI,6th Edition 2010.
4. RaoV.S.P,"HumanResourceManagement",Excelbooks,2nd Edition, 2010.
5. Lawrence.S.Kleeman,"HumanResourceManagement",Biztantra,3rd Edition, 2012.

B.E. MECHANICAL ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER - V

Mechatronics (3:0:0) 3

(Effective from the academic year 2020-21)

Course Code	**21ME545**	CIE Marks	50
Teaching Hours/Week (L:T:P)	**3:0:0**	SEE Marks	50
Total Number of Contact Hours	**40**	Exam Hours	03

Course objectives:

This course will enable students to:

1. UnderstandtheevolutionanddevelopmentofMechatronicsasadiscipline.
2. Substantiatetheneedforinterdisciplinarystudyintechnologyeducation.
3. Understand the applications of microprocessors in various systems and to know the functions of each element.
4. Demonstratetheintegrationphilosophyinviewof Mechatronicstechnology.

Module – 1

Introduction: System in the currents cenario, Industrial/defiance application, research in the field of ME, Impact of Mechatronics on society and sustainable solutions.

Introduction: Definition, Multi disciplinary Scenario, Evolution of Mechatronics, Design of Mechatronics system , Objectives ,advantages and disadvantages of Mechatronics.

Transducers and sensors: Definition and classification of transducers, Difference between transducer and sensor, Definition and classification of sensors, Principle of working and applications of light sensors, proximity switches and Hall Effect sensors.

(08 Hours)

Self-study topics: Recent advancement of sensors in an automobile

Module – 2

Microprocessor & Microcontrollers: Introduction, Microprocessor systems, Basic elements of control systems, Microcontrollers, Difference between Microprocessor and Microcontrollers.

Microprocessor Architecture: Microprocessor architecture and terminology-CPU, memory andaddress,I/OandPeripheraldevices,ALU,InstructionandProgram,Assembler,Data, Registers,ProgramCounter,Flags,Fetchcycle,writecycle,state,businterrupts.Intel's9400F Microprocessor.

(08 Hours)

Self-study topics: Working of house old three-way switch

Module – 3

Programmable logic controller: Introduction to PLC's, basic structure, Principle of operation, Programming and concept to fladderdiagram , concept to flatching & selection of a PLC.

Integration: Introduction & background, Advanced actuators, Pneumatic actuators, Industrial Robot, different part sofa Robot-Controller, Drive, Arm, End Effectors, Sensor& Functional requirements of robot

(08 Hours)

Self-study topics: Classification and Application of Robots

Module – 4

Basic Digital Technology: Digital number system, Binary number system, Hexadecimal number system, Binary addition, Boolean Algebra, Logic function , Universal GATES,FLIP- FLOP, Registers counters.

Electrical actuation systems: Electrical systems, Mechanical switches, Solenoids, Relays, DC/AC Motors, Principle of Stepper Motors & servomotors.

(08Hours)

Self-study topics: Application of servo motors

Module – 5

Pneumatic and hydraulic actuation systems: Actuating systems, Pneumatic and hydraulic systems, Classifications of Valves, Pressure relief valves, Pressure regulating/reducing valves, Cylinders and rotary actuators.

DCV&FCV: Principle & construction details, types of slidings poolvalve, solenoidoperated, Symbols of hydraulic elements, components of hydraulic system , functions of various units of hydraulic system.

(08 Hours)

Self-study topics: Design of simple hydraulic circuits for various applications

Course outcomes: The students will be able to:

CO1: Illustrate various components of Mechatronics systems.
CO2: Assess various control systems used in automation.
CO3: Analyze Interfacing of Sensors, Actuators using appropriate micro-controller and microprocessor
CO4 Describe electrical actuation systems, mechanical, hydraulic and pneumatic systems

Textbooks:

1. NitaigourPremchandMahalik.,"Mechatronics-Principles,ConceptsandApplications", 1stEdition, Tata McGraw Hill, 2017.
2. W. Bolton., "Mechatronics – Electronic Control Systems in Mechanical and Electrical Engineering", 6thEdition, Pearson Education, 2011.

References:

1. AnthonyEsposito.,"FluidPower",6thEdition,PearsonEducation,2011.
2. HMT, "Mechatronics", 1st Edition, Tata McGrawHill,2000.

B. E. MECHANICAL ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER – V

Applied Thermodynamics and Heat Transfer (2:1:0) 3

(Effective from the academic year 2021-22)

Course Code	**21ME55**	CIE Marks	50
Teaching Hours/Week (L: T:P)	**2:2:0**	SEE Marks	50
Total Number of lecture hours	**40**	Exam Hours	03

Course Objectives:

This course will enable students to:

1. Know the fundamental concepts of IC engines and various methods to estimate the Indicated power, Brake power, frictional power
2. Study the combustion phenomenon in SI and CI engines and its controlling actor in order to extract maximum power, use of alternative fuels in SI and CI engines.
3. Acquire the knowledge related to working principle and applications of various gas power cycles, gas turbine cycles and vapour power cycles.
4. To understand the concept to the at transfer and its different modes.
5. To understand the use of non-dimensional parameters, concepts of forced convection and free convection.
6. To understand the theory of radiation, heat exchangers, boiling and condensation.

Preamble:

Effect of engine performance on the environment, control measures to reduce the emission, recent trends in engine mechanisms, engines for regional and global economic growth.

Module-1

Internal Combustion Engines: Classification of IC engines, combustion phenomenon in SI and CI engines. Detonation and factors affecting detonation, different methods to measure indicated power, brake power, frictional power, performance analysis of I.C. engines, heat balance sheet, numerical problems.

(08 Hours)

Self-Study Component: Alternative fuels.

Module-2

Air Standard Cycles: Otto, Diesel, Dual cycle, P-V and T-S diagrams, description, efficiencies, mean effective pressures, Comparison of Otto, Diesel and Dual cycles. Numerical problems

Gas Turbine Cycles: description and analysis of Brayton cycle, numerical problems

(08 Hours)

Self-Study Component: Jet propulsion systems.

Module-3

Vapour Power Cycles: Carnot vapour power cycle, drawbacks as a reference cycle, Simple Rankine cycle, description, T-S diagram, and analysis for performance, comparison of Carnot cycle and Rankine cycles, effects of temperature and pressure on Rankine cycle performance. Actual vapour power cycles: Ideal and practical regenerative Rankine cycle, open and closed feed water heaters, reheat Rankine cycle, numerical problems.

(08 Hours)

Self-Study Component: Innovative ideas/ design features to incorporate in thermal power plant design for effective performance.

Module-4

Heat Transfer: Introduction, modes of heat transfer, basic laws governing conduction, convection and radiation, types of boundary conditions, derivation of general three-dimensional heat conduction equation in (i) Cartesian co-ordinates only, discussion of three-dimensional heat conduction equation in (ii) Polar and (iii) Spherical co-ordinate systems. Steady state one dimensional heat conduction problems (i) without heat generation (ii) constant thermal

conductivity in Cartesian system with various possible boundary conditions.

(08 Hours)

Self-Study Component: Importance of heat transfer in day today life, applications of heat transfer in various field based on the requirement, current research activity on heat transfer.

Module-5

Forced Convection: Boundary layer theory, velocity and thermal boundary layer theory, dimensionless numbers, various empirical solutions.

Free Convection: Laminar and turbulent flows, various empirical solutions.

Radiation: Introduction, properties and definitions, fundamental principles, radiation shield

Heat exchangers: Introduction, types of heat exchangers: parallel flow, counter flow and cross flow heat exchangers, applications, LMTD method.

Introduction to boiling, pool boiling, bubble growth mechanisms, Condensation: film wise and drop wise condensation.

(08 Hours)

Self-Study Component: Applications of solar radiation heat transfer in various fields.

Course Outcomes:

The student will be able to:

CO1: Summarize the fundamental concepts of thermodynamics, IC engines, different modes of heat transfer, forced convection, free convection, heat exchangers, boiling and condensation.

CO2: Apply the concepts of thermodynamics and heat transfer to IC engines, gas power cycles, vapour power cycles, forced convection, free convection, radiation, heat exchangers, boiling and condensation.

CO3: Analyze IC Engine parameters, gas power cycles and vapour cycles for optimum performance.

CO4: Evaluate the performance parameters of IC engines, air standard cycles and gas turbines.

CO5: Create the heat balance sheet to get the necessary information for the better performance of IC engine.

Textbooks:

1. P.K. Nag," Basic and Applied Thermodynamics",Tata Mc GrawHill, 6thedition, 2015.
2. R.K.Rajput,"ThermalEngineering",LaxmiPublications,11thedition, 2020.
3. P.K.Nag.,"HeatandMassTransfer",TataMcGrawHill,3rdEdition, 2011.

References:

1. Yunus A.Cenegal.,MichaelA.Boles,"Thermodynamics-AnEngineeringApproach",
2. Tata McGraw Hill publications, 7thedition, 2001.
3. GanesanV,"I.C.Engines",TataMcGrawHill,4thedition, 2012.
4. J.P.Holman.,"HeatTransfer",TataMcGrawHill,9thedition, 2008.
5. M. Thirumaleshwar., "Fundamentals of Heat and Mass Transfer", Dorling Kindersley,1st edition, 2009.

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B.E. MECHANICAL ENGINEERING
Choice Based Credit System (CBCS)
SEMESTER - V

Design of Machine Elements (3:0:0) 3
(Effective from the academic year 2021-22)

Course Code	**21ME56**	CIE Marks	50
Teaching Hours/Week (L:T:P)	**3:0:0**	SEE Marks	50
Total Number of Contact Hours	**40**	Exam Hours	03

Course objectives:

This course will enable students to:

1. Able to understand mechanical design procedure, materials, codes and standards.
2. Able to design machine components for static, impact and fatigue strength.
3. Able to design fasteners, shafts, joints, power screws.

Preamble: Introduction on importance and impact of machine design on environment, economy and customer satisfaction.

Module – 1

Introduction: Definitions: normal, shear, biaxial and triaxial stresses, stress tense, principal stresses. Phases of design process, engineering materials and their mechanical properties, stress analysis, design considerations, codes and standards. Stress concentrations, determination of stress concentration actor.

(09Hours)

Self-Study Component: Various ways to overcome problem of stress concentration, design of components using theories of failure

Module – 2

Design for impact and fatigue loads: Impact strength; Introduction, impact stresses due to axial, bending and torsion loads.

Fatigue: Introduction to S-N diagram, Low cycle fatigue, high cycle fatigue, Goodman and Soderberg relationship, endurance limit, endurance limit modifying factors; size effect, surface, stress concent ration effects, fluctuating stresses, stresses due to combined loading.

(07 Hours)

Self-Study Component: Various cases of fatigue failures of mechanical components.

Module – 3

Design of Shafts: Torsion of shafts, design for strength and rigidity with steady loading, ASME codes for power transmission shafting, shafts under combined loads.

(08 Hours)

Self -Study Component: Various types of keys, Design of keys for shafts.

Module – 4

Riveted and Welded joints: Rivet types, Rivet materials, Failures of riveted joints, joint efficiency, boiler joints, design of eccentrically loaded riveted joints.
Welded joints- Types, strength of butt and fillet welds, eccentrically loaded welded joints.
(07 Hours)

Self- Study Component: Design of diamond joints, out of plane eccentric welded joints.

Module – 5

Threaded fasteners and Power screws: Stresses in threaded fasteners, effect of initial tension, design of threaded fasteners under static loading. Types of power screws, efficiency and self-locking, design of power screw.

Design of Helical Compression Springs: Types of springs- stresses in Helical coil spring for circular cross sections.

(09 Hours)

Self-Study Component: Design of screw jack.

Course outcomes:

The students will be able to:

CO 1: Understand the concept of safe machine design for static loading taking stress concentration into account.
CO 2: Design for impact strength.
CO 3: Design machine elements for fatigue strength.
CO 4: Design welded joints, riveted joints, fasteners and power screws.
CO 5: Analyze and design the shafts.

Textbooks:

1. Joseph. E. Shigley, Charles. R. Mischke, "Mechanical Engineering Design", McGraw Hill International, 6th Edition, 2009.
2. C.S.Sharma, Kamalesh Purohit, "Design of Machine Elements", Prentice Hall of India Private Limited, 7th Edition, 2006.

References:

1. Robert.L. Norton," Machine Design–An Integrated Approach", Pearson Education,3rd Edition,2001.
2. George. E. Dieter, Linda. Schmidt, "Engineering Design", Indian Edition, McGraw Hill Education,2003.
3. Hall, Holowenko, "Engineering Design", Special Indian Edition, Laughlin (Schaum's Outline series), 2008.
4. V. B. Bhandari., "Design of Machine Elements", Tata McGraw Hill Publishing Company Ltd,2nd Edition, 2007.

Design Data Handbook

1. K. Mahadevan., Balaveera Reddy., "Design Data Handbook", CBS publication, 4th Edition, 2001.

B.E MECHANICAL ENGINEERING

(Choice Based Credit System (CBCS)

SEMESTER - V

Theory of Machines (3:0:0) 3

(Effective from the academic year 2021-22)

Course Code	21ME57	CIE Marks	50
Teaching Hours/Week (L: T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	03

Course Objectives:

This course will enable students to:

1. To understand the concept of machines, mechanisms and related terminologies.
2. To understand the theory of cams, gears, gear trains and belt drives.
3. To understand the working of clutches, breaks, bearings, gyroscope and governors.
4. To understand the principles in mechanisms used for speed control and stability control.
5. To know the concepts of vibration mechanical systems using spring, mass and damper elements.

Preamble: working of various machines, application of mechanisms in various field based on the requirement.

Module – 1

Mechanisms: Structures, Machines, mechanisms, static, kinetic, mechanisms and Mechanism terminologies, degrees of freedom, Classification links and pairs, Groshoff's law, Inversions of Slider crank and four bar mechanisms.

Planer Mechanisms: Quick return motion mechanisms-Drag link mechanism, Whitworth mechanism and Crank and slotted lever Mechanism. Oldham's coupling, Straight line motion mechanisms, Intermittent Motion mechanisms.

Velocity and Acceleration Analysis: Velocity and Acceleration Analysis of Four bar mechanism and Single slider crank mechanisms.

Self-study Component: Synthesis of mechanisms for various applications.

(08 Hours)

Module – 2

Spur Gears: Gear terminology, law of gearing, path of contact, arc of contact, contact ratio of spur gear.Interference in involute gears, methods of avoiding interference, back lash.

Gear Trains: Simple gear trains, compound gear trains. Epicyclic gear trains: Algebraic and tabular methods of finding velocity ratio of epicyclic gear trains.

(08 Hours)

Self-study component: Applications of helical gears, bevel gears.

Module – 3

Cams: Types of cams, Types of followers, Follower displacement programming, Derivatives of follower Motion, Motions of follower, Layout of cam profiles.

Friction: introduction to friction, types of friction. law of friction, coefficient of friction, friction at inclined plane.

Clutch and Brake: friction clutches- Plate clutch, cone clutch, centrifugal clutch, types of brakes- block and shoe brakes, band brake, internal expanding shoe brake, braking effect in vehicle.

Bearings: Types of bearing- sliding contact bearing, Rolling contact bearing.

(08 Hours)

Self-Study Component: Magnetic bearings and Air bearings

Module – 4

Governors: Types of governors, force analysis of Porter and Hartnell governors. Controlling force, Stability, Sensitiveness, Isochronism, Effort and Power.

Gyroscope: Vectorial representation of angular motion, Gyroscopic couple. Effect of gyroscopic couple on plane disc, airplane, ship, stability of two wheelers and four wheelers, numerical problems.

(08 Hours)

Self-study component: Applications of governors.

Module – 5

Vibration: Introduction, Basic elements of vibrating system.

Free vibration: Types of free vibration, Longitudinal Vibrations-Equilibrium method, D'Alembert's principle, Energy method, Rayleigh's method.

Damped free vibrations: Under damped, over damped and critically damped systems. Logarithmic decrement.

Forced vibration: Undamped forced vibration of spring mass system, damped forced vibrations, Vibration isolation.

(08 Hours)

Self-study component: Single and multi degree of freedom system.

Course outcomes:

The students will be able to:

CO1: Apply acquired knowledge of basic mechanisms to study the working of different mechanisms.
CO2: Analyze the motion of gears and cams.
CO3: Analyze the friction and forces of Clutch, Brake, governors, and gyroscopes.
CO4: Classify the vibrational characteristics of various machine components.

Textbooks:

1. Theory of Machines, Rattan S.S. Tata McGraw Hill Publishing Company Ltd., New Delhi, 5th Edition, 2019.
2. Theory of Machines, Sadhu Singh, Pearson Education, 4th Edition. 2009.
3. Mechanism and Machine Theory, A. G. Ambekar PHI, 2007.

References:

1. Mechanisms and Machines-Kinematics, Michael M Stanisic, Dynamics and Synthesis, Cengage Learning, **4th Edition** 2016.
2. Theory of Machines & Mechanisms", J.J. Uicker, G.R. Pennock, J.E. Shigley, Oxford University Press, New York, 5**th Edition** 2017.

B.E MECHANICAL ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER - V

Energy Conversion Lab (0:0:1) 1

(Effective from the academic year 2021 -2022)

Course Code	**21MEL58A**	CIE Marks	50
Teaching Hours/Week (L:T:P)	**0:0:2**	SEE Marks	50
Total Number of Contact Hours	**26**	Exam Hours	03

Course objectives:

This course will enable students to:

1. This course will provide a basic understanding of fuel properties and its measurements using various types of measuring devices
2. Energy conversion principles, analysis and understanding of I C Engines will be discussed. Application of these concepts for these machines will be demonstrated. Performance analysis will be carried out using characteristic curves.
3. Exhaust emissions of I C Engines will be measured and compared with the standards.

PART-A

1. Lab layout, calibration of instruments and standards, emission norms, trends in IC engines to be discussed.
2. Determination of flash point and Fire point of lubricating oil using Abel Pensky and Marten's (closed) / Cleveland's (Open Cup) apparatus.
3. Determination of calorific value of gaseous fuels.
4. Determination of viscosity of lubricating oil using Redwoods, Say bolt and Torsion Viscometers.
5. Valve Timing diagram of an I.C. Engine (4-S Diesel engine).

PART-B

1. Performance Tests on I.C. Engines, Calculations of IP, BP, Thermal efficiency, Volumetric efficiency, Mechanical efficiency, SFC, FP, A:F Ratio, heat balance sheet for:
   a. Single cylinder four stroke Diesel Engine.
   b. Single cylinder four stroke Petrol Engine.
   c. Multi Cylinder Petrol Engine, (Morse test).
   d. Single cylinder four stroke Variable Compression Ratio Engine.
2. Measurements of Exhaust Emissions of Diesel engine.
3. Demonstration of pθ, pV plots using Computerized IC engine test rig.

Course Outcomes:

The student will be able to:

CO1: Perform experiments to determine the properties of fuels and oils.

CO2: Determine the energy flow pattern through the I C Engine, and conduct experiments on engines and draw characteristic curves.

CO3: Exhibit his competency towards preventive maintenance of IC engines. Identify exhaust emission, factors affecting them and report the remedies.

Assessment methods:

I. Continuous Internal Evaluation (CIE): 50 Marks

The marks for the record write-up and internal assessment will be in the ratio of 60:40. Record will be continuously evaluated for each experiment with regard to conduction, write-up and viva-voce: 30Marks.

Internal Test will be conducted for 100 Marks and reduced to 20 Marks.

II. Semester End Examination (SEE): 50 Marks

SEE is conducted for 100 Marks and reduced to 50 Marks.

Question paper pattern:

One question from Part-A : 30 Marks

One question from Part-B	: 50 Marks
Viva – Voce	: 20 Marks
TOTAL	**: 100 Marks**

B.E. MECHANICAL ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER - V

Heat Transfer Lab (0:0:1) 1

(Effective from the academic year 2021-22)

Course Code	**21MEL58B**	CIE Marks	50
Teaching Hours/Week (L:T:P)	**0:0:2**	SEE Marks	50
Total Number of Contact Hours	**26**	Exam Hours	03

Course objectives:

This course will enable students to:

1. The primary objective of this course is to provide the fundamental knowledge necessary to understand the behavior of thermal systems.
2. This course provides a detailed experimental analysis, including the application and heat transfer through solids, fluids, and vacuum.
3. Convection, conduction, and radiation heat transfer in one and two dimensional steady and unsteady systems are examined.

Part - A

1. Determination of Thermal Conductivity of a Metal Rod.
2. Determination of Overall Heat Transfer Coefficient of a Composite wall.
3. Determination of Effectiveness on a Metallic fin.
4. Determination of Heat Transfer Coefficient in free Convection
5. Determination of Heat Transfer Coefficient in a forced Convention
6. Determination of Emissivity of a Surface.

Part - B

1. Determination of Stefan Boltzmann Constant.
2. Determination of LMDT and Effectiveness in a Parallel Flow and Counter Flow Heat Exchangers.
3. Experiments on Boiling of Liquid and Condensation of Vapor.
4. Performance Test on Vapour Compression Refrigeration.
5. Performance Test on a Vapour Compression Air – Conditioner.
6. Experiment on Transient Conduction Heat Transfer.

Course outcomes:

The students will be able to:

CO 1:Determine the thermal conductivity of a metal rod and overall heat transfer coefficient of composite slabs.

CO 2:Analyze convective heat transfer coefficient for free and forced convection and correlate with theoretical values.

CO 3: Evaluate temperature distribution characteristics of steady and transient heat conduction through solid cylinder experimentally.

CO 4:Determine surface emissivity of a test plate and Stefan Boltzmann constant.

CO 5:Estimate performance of a refrigerator and effectiveness of a fin and Double pipe heat exchanger.

Assessment methods:

III. Continuous Internal Evaluation (CIE): 50 Marks

The marks for the record write-up and internal assessment will be in the ratio of 60:40. Record will be continuously evaluated for each experiment with regard to conduction, write-up and viva-voce: 30Marks.

Internal Test will be conducted for 100 Marks and reduced to 20 Marks.

IV. Semester End Examination (SEE): 50 Marks

SEE is conducted for 100 Marks and reduced to 50 Marks.
Question paper pattern:
One question from Part-A: 30 Marks
One question from Part-B : 50 Marks
Viva – Voce : 20 Marks
TOTAL : 100 Marks

B.E. MECHANICAL ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER - V

Design Lab (0:0:1) 1

(Effective from the academic year 2021-22)

Course Code	**21MEL58C**	CIE Marks	50
Teaching Hours/Week (L:T:P)	**0:0:2**	SEE Marks	50
Total Number of Contact Hours	**26**	Exam Hours	03

Course objectives:

This course will enable students to:

1. Able to determine vibration characteristics and critical speed of shaft experimentally and compare the same with theoretical calculations.
2. Able to determine material fringe constant of photo elastic material and find out stresses.
3. Able to determine stresses in curved beam, principal stresses in in a member and understand the pressure distribution in a journal bearing.
4. Able to estimate various parameters of a Governor.

Part - A

1. Determination of natural frequency, logarithmic decrement, damping ratio and damping coefficient in a single degree of freedom damped longitudinal vibrating systems.
2. Determination of undamped natural frequency of a spring mass system and damping ratio of a transverse vibration system
3. Balancing of rotating masses.
4. Determination of critical speed of a rotating shaft.
5. Determination of Fringe constant of Photo elastic material using.
    a. Circular disc subjected to diametric compression.
    b. Pure bending specimen (four point bending)
6. Determination of stress concentration factor using Photo elasticity for circular disk with circular hole under compression, stresses in 2D Crane hook

Part - B

1. Determination of equilibrium speed, sensitiveness, power and effort of Porter/ Prowel
2. /Hartnel Governor. (only one)
3. Determination of Pressure distribution in Journal bearing and calculation of coefficient of viscous friction.
4. Determination of Principal Stresses and strains in a member subjected to combined loading using Strainrosettes.
5. Determination of stresses in Curved beam using strain gauge.
6. Experiments on Gyroscope (Demonstrationonly).

Course outcomes:

The students will be able to:

CO 1: Calculate stresses. In various specimens through photo elasticity technique.

CO 2: Estimate the stresses using strain gauge techniques.

CO 3: Predict the vibrational parameters of the given springs.

CO 4: Explain journal bearing characteristics.

CO 5: Estimate the governor parameters such as effort power lost

Assessment methods:

I. Continuous Internal Evaluation (CIE): 50 Marks

The marks for the record write-up and internal assessment will be in the ratio of 60:40. Record will be continuously evaluated for each experiment with regard to conduction, write-up and viva-voce: 30Marks.
Internal Test will be conducted for 100 Marks and reduced to 20 Marks.

II. Semester End Examination (SEE): 50 Marks

SEE is conducted for 100 Marks and reduced to 50 Marks.
Question paper pattern:

One question from Part-A	: 30 Marks
One question from Part-B	: 50 Marks
Viva – Voce	: 20 Marks
TOTAL	**: 100 Marks**