MADANAPALLE INSTITUTE OF TECHNOLOGY & SCIENCE

(UGC Autonomous Institution)
Affiliated to JNTUA, Anantapur & Approved by AICTE, New Delhi
(An ISO 9001-2008 Certified Institution)
Post Box No. 14, Angallu, Madanapalle – 517325.
Ph. 08571-280255, 280706, Fax: 08571-280433
Web: www.mits.ac.in

DEPARTMENT OF MECHANICAL ENGINEERING

CIRCULAR

Date: 15-06-2023

It is hereby informed to all the faculty members that **Board of Studies (BoS)** meeting is scheduled on 17-06-2023 at 02:00 pm (Online Mode) for reviewing the course structure and syllabus for third year (I semester & II semester) R20 syllabus.

Agenda:

1. Discuss about the PO/PSO attainment of 2018-22 batch
2. Reviewing fourth year R-20 syllabus
3. Discussion on fourth year R-20 Honors and Minor Subjects
4. Discussion on department vision and mission

Meeting Link:

https://teams.microsoft.com/_#/l/meetup-join/19:meeting_Nzc2YjE5NWEtODAxYi00ODRjLWIzMzItMTVkYjE5NDE5MDYz@thread.v2/0?context=%7B%22Tid%22%3A%22b637c4f6-57b7-44dc-bce4-fec0cd202460%22,%22Oid%22:%228d1d9056-9ba8-4186-b8a9-267c2f572157-%22%7D&anon=true&deeplinkId=e6d80687-9e66-4686-bbdf-6ff6bb502140

The following BoS members are requested to attend the meeting.

Sl. No.	Name of the Member	Designation
1.	**Dr. C. Yuvaraj**	Professor & Head of the Institution, MITS
2.	**Dr. M. Lakshmana Rao** (BoS - Chairman)	Professor & Head of the Department, ME
3.	**Dr. P. Ramanathan**	Vice Principal Academics, MITS
4.	**Dr. B. Durga Prasad** (JNTUA University Nominee)	Professor, Mechanical Department, JNTUA CEA, Ananthapuramu.
5.	**Dr. E. Anil Kumar** (Subject Expert)	Professor, Mechanical Engineering, IIT, Tirupati.
6.	**Dr. B. Venkatesham** (Subject Expert)	Professor, Mechanical and Aerospace Engineering, IIT, Hyderabad.
7.	**Mr. Kashinath M Patnasetty** (Industry Expert)	Head, VAS Application Support Ace Designers Limited, Bangalore.
8.	**Mr. Anand Swaroop Donepudi** (Alumni)	Product and Application Engineer CBRE South Asia Pvt. Ltd.,
9.	**Dr. I. Arun**	Professor & Research Coordinator-ME
10.	**Dr. S. Baskaran**	Assoc. Professor & IQAC Coordinator-MITS

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11.	**Dr. K. V. Nagesha**	Assoc. Professor & NBA Coordinator-ME
12.	**Dr. P. Sivaiah**	Assoc. Professor & Workshop Incharge-ME
13.	**Dr. R. Prithivi Rajan**	Assoc. Professor & Project Coordinator-ME
14.	**Dr. Kamlesh Kumar**	Assoc. Professor & Placement Coordinator-MITS
15.	**Dr. Anantha Raman L**	Assistant Professor & Academic Coordinator-ME
16.	**Dr. Arun Kumar.D**	Assistant Professor & IQAC Coordinator-ME
17.	**Dr. Manish Sharma**	Assistant Professor & CO-PO Mapping Coordinator-ME
18.	**Dr. Satyajit Pattanayak**	Assistant Professor & & Placement Coordinator-ME

Dr. M. Lakshmana Rao
Professor & Head, Department of ME

Head of the Department
Mechanical Engineering
Madanapalle Institute of Technology & Science

Copy to

- The Principal
- The Vice-Principal (Academics)
- BoS & Department file

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Date: 15-06-2023

COMPOSITION AND APPROVAL OF BOARD OF STUDIES (BoS)

The following members are nominated and approved for constitution of Board of Studies (BoS).

Sl. No.	Member Name	Designation
1.	**Dr. C. Yuvaraj**	Professor & Head of the Institution, MITS
2.	**Dr. M. Lakshmana Rao** (BoS - Chairman)	Professor & Head of the Department, ME
3.	**Dr. P. Ramanathan**	Vice Principal Academics, MITS
4.	**Dr. B. Durga Prasad** (JNTUA University Nominee)	Professor, Mechanical Department, JNTUA CEA, Ananthapuramu.
5.	**Dr. E. Anil Kumar** (Subject Expert)	Professor, Mechanical Engineering, IIT, Tirupati.
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8.	**Mr. Anand Swaroop Donepudi** (Alumni)	Product and Application Engineer CBRE South Asia Pvt. Ltd.,
9.	**Dr. I. Arun**	Professor & Research Coordinator-ME
10.	**Dr. S. Baskaran**	Assoc. Professor & IQAC Coordinator-MITS
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14.	**Dr. Kamlesh Kumar**	Assoc. Professor & Placement Coordinator-MITS
15.	**Dr. Anantha Raman L**	Assistant Professor & Academic Coordinator-ME
16.	**Dr. Arun Kumar.D**	Assistant Professor & IQAC Coordinator-ME
17.	**Dr. Manish Sharma**	Assistant Professor & CO-PO Mapping Coordinator-ME
18.	**Dr. Satyajit Pattanayak**	Assistant Professor & & Placement Coordinator-ME

Responsibilities of the committee:

1. Monitors attainment of COs, POs & PSOs.
2. Evaluate program effectiveness and process necessary changes in mechanical department curriculum.

Dr. M. Lakshmana Rao
Chairman-BoS, Professor & Head, Department of ME

Head of the Department
Mechanical Engineering
Madanapalle Institute of Technology & Science
MADANAPALLE - 517 325

Dr. C. Yuvaraj
Principal, MITS

Principal
Madanapalle Institute of
Technology & Science
MADANAPALLE

Copy to

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- The Vice-Principal (Academics)
- BoS & Department file

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DEPARTMENT OF MECHANICAL ENGINEERING

Date: 20-06-2023

Board of Studies (BoS)
Minutes of meeting held on 17-06-2023, 02:00 PM – 04:00 PM & Action taken report.
Venue: Microsoft Teams (Online Meeting)

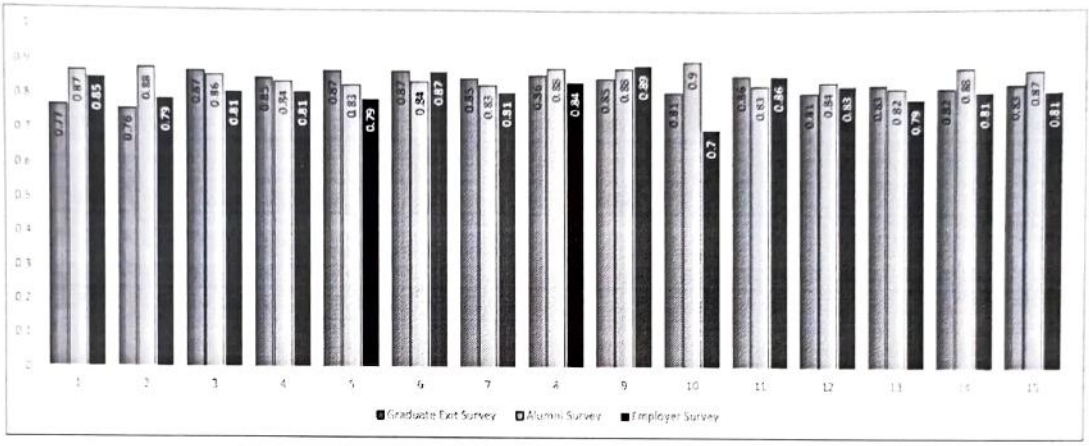
Agenda:

1. Discuss the PO/PSO attainment of the 2018-22 batch.
2. Reviewing fourth year R-20 B. Tech (Mechanical Engineering) syllabus.
3. Discussion on fourth-year R-20 B. Tech Mechanical Engineering course structure.
4. Discussion on fourth-year Honors & Minors Program Courses & Syllabi.
5. Discussion on Department Vision and Mission.

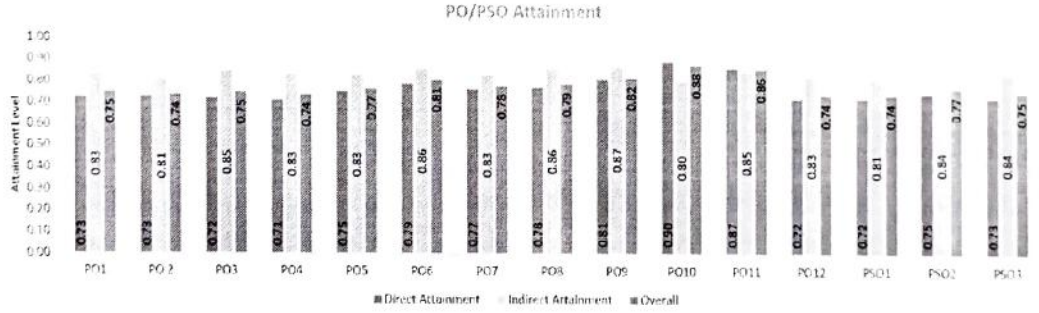
Minutes:

1. The Head of the Department, Dr. M. Lakshmana Rao welcomed all members to the BoS meeting.
2. Dr. M. Lakshmana Rao introduced external members to the participants.
3. Dr. M. Lakshmana Rao introduced internal members to the participants.
4. Dr. M. Lakshmana Rao presented an overview of the Institution, Department, Recent Activities, and Achievements.
5. Dr. M. Lakshmana Rao presented the agenda of the BoS meeting.
6. Dr. M. Lakshmana Rao handed the session to Dr. Anantha Raman L., academic coordinator to present PO/PSO attainment of 2018-2022 B.Tech. Mechanical batch.
7. Dr. Anantha Raman L. presented the recommendations of PAC & IAAB at the BoS meeting.
8. Dr. Anantha Raman L. presented the overall and subject-wise PO/PSO attainment of 2018-2022 B.Tech. Mechanical batch.
9. PO6, PO10, and PO11 have attainment levels "3" and the remaining PO attainment levels were "2".It has been observed that the PO/PSO attainment levels were low for PO/PSOs mapped with analytical subjects with higher bloom levels.
10. The PO/PSO levels of 2016-20, 2017-21 and 2018-22 were compared.
11. The PO/PSO attainment levels for the 2018-2022 batch are mentioned below:

PO Indirect Attainment															
Graduate Exit Survey	0.77	0.76	0.87	0.85	0.87	0.87	0.85	0.86	0.85	0.81	0.86	0.81	0.83	0.82	0.83
Alumni Survey	0.87	0.88	0.86	0.84	0.83	0.84	0.83	0.88	0.88	0.9	0.83	0.84	0.82	0.88	0.87
Employer Survey	0.85	0.79	0.81	0.81	0.79	0.87	0.81	0.84	0.89	0.7	0.86	0.83	0.79	0.81	0.81
Average	0.83	0.81	0.85	0.83	0.83	0.86	0.83	0.86	0.87	0.80	0.85	0.83	0.81	0.84	0.84



Assessment Method	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Direct Attainment	0.73	0.73	0.72	0.71	0.75	0.79	0.77	0.78	0.81	0.90	0.87	0.72	0.72	0.75	0.73
Indirect Attainment	0.83	0.81	0.85	0.83	0.83	0.86	0.83	0.86	0.87	0.80	0.85	0.83	0.81	0.84	0.84
Overall	0.75	0.74	0.75	0.74	0.77	0.81	0.78	0.79	0.82	0.86	0.86	0.74	0.74	0.77	0.75
Average Attainment	2	2	2	2	2	3	2	2	3	3	3	2	2	2	2



12. Dr. Anantha Raman L. presented the course structure for R20 4-1, and 4-2 semesters and presented syllabi for all Courses to be offered in 4-1 semester.
13. The summer internship is mandatory for all students. Every student must undergo an internship during their 2-2 & 3-2 semesters vacations. They need to submit a report on the internship undergone during the upcoming semester, i.e., 3-1 & 4-1.
14. The course structure for 4-1 & 4-2 semesters are mentioned below:

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IV Year I Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	PE		Professional Elective-III (Annexure-III)	3	0	0	3	3
2	PE		Professional Elective-IV (Annexure-III)	3	0	0	3	3
3	PE		Professional Elective-V (Annexure-III)	3	0	0	3	3
4	OE		Open Elective-III (Annexure-II)	3	0	0	3	3
5	OE		Open Elective-IV (Annexure-II)	3	0	0	3	3
6	OE-HSMC		Open Elective-V (Taken from Humanities & Social Science) (Annexure-II)	3	0	0	3	3
7	SC		Skill Oriented Course-V (Annexure-IV)	1	0	2	3	2
8	PROJ	20ME702	Summer Internship-II *	0	0	6	6	3
Total				**19**	**0**	**8**	**27**	**23**

* 2 Months' internship during 3rd-year summer vacation and to be evaluated in IV Year I Semester

IV Year II Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	PROJ	20ME703	Project Work, Seminar, and Internship in Industry (6 months)	0	0	24	24	12
Total				**0**	**0**	**24**	**24**	**12**

15. The list of Professional Elective-III, IV & V subjects offered for 4-1 semester is listed below.

Professional Elective – III		
Sl. No.	**Course Code**	**Course Title**
1.	20ME407	Entrepreneurship and Project Management
2.	20ME408	Refrigeration and Air Conditioning
3.	20ME409	Internet of Manufacturing Things
4.	20ME410	Renewable Energy Systems
5.	20ME411	Nano Technology
Any advanced courses can be appended in future.		

Professional Elective – IV		
Sl. No.	**Course Code**	**Course Title**
1.	20ME412	Electric Vehicle Technology
2.	20ME413	Additive Manufacturing
3.	20ME414	Fundamentals of Aerodynamics
4.	20ME415	Non Destructive Testing
5.	20ME416	Total Quality Management
Any advanced courses can be appended in future.		

Professional Elective – V		
Sl. No.	**Course Code**	**Course Title**
1.	20ME417	Mechanical Vibrations
2.	20ME418	Gas Dynamics and Jet Propulsion
3.	20ME419	Manufacturing of Composite Materials
4.	20ME420	Power Plant Engineering
5.	20ME421	Operations Research
Any advanced courses can be appended in future.		

16. The list of Skill Oriented Course-V subjects offered for 4-1 semester is listed below.

Skill Oriented Course– V		
Sl. No.	**Course Code**	**Course Title**
1	20ME604	Advanced Manufacturing Technologies

17. The list of Open Elective IV subjects offered for 4-1 semester for other branches of engineering is listed below.

Sl. No.	Course Code	Course Title
1.	20ME304	Total Quality Management
2.	20ME305	Entrepreneurship

18. The list of courses for Honors in Mechanical Engineering (20 Credits) has been discussed:

Honors in Mechanical Engineering

Sl. No	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total Contact Hours	
III Year I Semester								
1	**Professional Elective Course (Choose any two from three courses)**	20HDME101	Advanced Welding Technology	3	0	0	3	3
2		20HDME102	Design and Analysis of Welded Structures	3	0	0	3	3
3		20HDME103	Combustion and Emissions	3	0	0	3	3
	Sub Total			**6**	**0**	**0**	**6**	**6**
	III Year II Semester							
4	**Professional Elective Course** (Choose any two from three courses)	20HDME104	Ergonomics	3	0	0	3	3
5		20HDME105	Solar Energy for Process Heat and Power Generation	3	0	0	3	3
6		20HDME106	Fracture Mechanics	3	0	0	3	3
	Sub Total			**6**	**0**	**0**	**6**	**6**

	IV Year I Semester							
7	**Professional Elective Course** (Choose any one from three courses)	20HDME107	Powder Metallurgy	3	0	0	3	3
8		20HDME108	Advanced Fluid Mechanics	3	0	0	3	3
9		20HDME109	Modeling of SI and CI Engines	3	0	0	3	3
10	**SOC**	20HDME601	Simulation and Analysis using ANSYS	1	0	2	3	2
			Sub Total	**7**	**0**	**2**	**9**	**8**
			Total	**19**	**0**	**2**	**21**	**20**

19. The list of courses for Minors in Mechanical Engineering (20 Credits) has been discussed and listed below. The department offers minors in 2 streams viz., 1. Digital Manufacturing and 2. Energy Engineering.

Minors in Mechanical Engineering
(Applicable to CE, EEE, ECE, CSE, CST, CS – AI, CS – DS, CS – CSY & CS - IOT)
Stream Name: Digital Manufacturing

Sl. No	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total Contact Hours	
III Year I Semester								
1	**Professional Core Course**	20MDME101	Computer Aided Manufacturing Process	3	0	0	3	3
2	**Professional Core Course**	20MDME102	Product Design and Development	3	0	0	3	3

III Year II Semester								
3	**Professional Core Course**	20MDME103	Digital Manufacturing Planning and Control	3	0	0	3	3
4	**Professional Core Course**	20MDME104	Big Data Analytics for Manufacturing	3	0	0	3	3
5	**Professional Core Course**	20MDME201	Computer Aided Design and Manufacturing Laboratory	0	0	4	4	2
IV Year I Semester								
6	**Professional Core Course**	20MDME105	Smart Sensors and Industry 4.0	3	0	0	3	3
7	**Professional Core Course**	20MDME106	Lean Manufacturing	3	0	0	3	3
			Total	**18**	**0**	**4**	**22**	**20**

Minors in Mechanical Engineering
(Applicable to CE, EEE, ECE, CSE, CST, CS – AI, CS – DS, CS – CSY & CS - IOT)
Stream Name: Energy Engineering

Sl. No	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total Contact Hours	
III Year I Semester								
1	**Professional Core Course**	20MDME107	Fluid Mechanics and Hydraulic Machinery	2	1	0	3	3
2	**Professional Core Course**	20MDME108	Applied Thermodynamics	2	1	0	3	3

III Year II Semester								
3	**Professional Core Course**	20MDME109	Heat Transfer	2	1	0	3	3
4	**Professional Core Course**	20MDME110	Computational Fluid Dynamics	2	1	0	3	3
5	**Professional Core Course**	20MDME202	Thermal Engineering Laboratory	0	0	4	4	2
IV Year I Semester								
6	**Professional Core Course**	20MDME111	Design of Gas Turbine Engines	2	1	0	3	3
7	**Professional Core Course**	20MDME112	Fluid Power System	2	1	0	3	3
			Total	**12**	**6**	**4**	**22**	**20**

20. Dr. Anantha Raman L. presented the syllabus of each subject in detail.
21. Professional Elective III Subjects:
    - Dr. Anantha Raman L. has presented the list of subjects offered as professional elective III. He has explained the detailed syllabus of all professional elective III subjects.
22. 20ME407 Entrepreneurship and Project Management:
    - Members suggested to make the Course less theoretical and more case study type.
    - Members suggested to include content which can give practical exposure to students.
    - All suggestions given by the members were implemented.
23. 20ME408 Refrigeration and Air Conditioning:
    - Suggestions were provided to include multi-stage and cascading VCR systems.
    - All suggestions given by the members were implemented.

24. 20ME409 Internet of Manufacturing Things:
    - All members accepted the syllabus as it is.
25. 20ME410 Renewable Energy Systems:
    - Suggestions were given to include hydrogen production, storage, and fuel cell related contents in appropriate units.

- All suggestions given by the members were implemented.

26. 20ME411 Nano Technology:
    - All members accepted the syllabus as it is.
27. Professional Elective IV Subjects:
    - Dr. Anantha Raman L. has presented the list of subjects offered as professional elective IV. He has explained the detailed syllabus of all professional elective IV subjects.
28. 20ME412 Electric Vehicle Technology:
    - Suggestions were given to include Safety & Environment Aspects related contents in appropriate units.
    - All suggestions given by the members were implemented.
29. 20ME413 Additive Manufacturing:
    - Suggestions were given to include Defects in AM and Functional effects related contents in appropriate units.
    - All suggestions given by the members were implemented.
30. 20ME414 Fundamentals of Aerodynamics:
    - Suggestions were given to include applications of aerodynamics, esp. in automobile sector in appropriate units.
    - All suggestions given by the members were implemented.
31. 20ME415 Non-Destructive Testing:
    - All members accepted the syllabus as it is.
    - Mr. Kashinath M Patnasetty suggested that training is needed for faculty in the NDT lab in Bangalore. He also suggested to establish economic lab in MITS campus for consultancy and research works.
32. 20ME416 Total Quality Management:
    - Suggestions were given to include Case studies and TQM principles followed by Indian Industries under unit 5.
    - All suggestions given by the members were implemented.
33. Professional Elective V Subjects:
    - Dr. Anantha Raman L. has presented the list of subjects offered as professional elective V. He has explained the detailed syllabus of all professional elective V subjects.
34. 20ME417 Mechanical Vibrations:
    - Suggestions were given to combine unit 1 & 2. Move unit 3 to unit 2. Add Multi degree freedom systems related content in unit 3.
    - Suggestions were given to emphasis more on fundamentals of vibrations which will be helpful for placements and industry-related core jobs.
    - All suggestions given by the members were implemented.
35. 20ME418 Gas Dynamics and Jet Propulsion:
    - Dr. Anantha Raman L. has presented the syllabus for Gas Dynamics and Jet Propulsion.
    - All members accepted the syllabus as it is.

36. 20ME419 Manufacturing of Composite Materials:
    - All members accepted the syllabus as it is.
37. 20ME420 Power Plant Engineering:
    - Suggestions were given to include nuclear power plants, diesel power plants and hydro power plants in appropriate units.
    - All suggestions given by the members were implemented.
38. 20ME421 Operations Research:
    - All members accepted the syllabus as it is.
39. Skill Oriented Course:
    - Dr. Anantha Raman L. has presented the list of subjects offered as SOC. He has explained the detailed syllabus of SOC subjects.
40. 20ME604 Advanced Manufacturing Technologies:
    - Suggestions were given to include the fundamentals of 3D printing and sequential procedures to be followed.
    - All suggestions given by the members were implemented.
41. Honors & Minors:
    - Dr. Anantha Raman L. has presented the list of subjects offered as Honors & Minors for 4-1 semester. He has explained the detailed syllabus of all honors and minors subjects and the same has been approved by all the members.
42. Dr. Anantha Raman L. explained the credits distribution semester-wise and category-wise to all the members.
43. Dr. Anantha Raman L. presented the department's vision and mission.
44. Mr. Kashinath M Patnasetty suggested changing the vision statement beginning as "To be a preferred center of excellence"
45. Dr. M. Lakshmana Rao concluded the meeting and thanked all the members for attending and contributing to the improvement of the curriculum and syllabus.
46. The revised subject-wise syllabus of all 4-1 & 4-2 subjects has been attached with the minutes for reference.
47. A few screenshots of the online meeting are displayed below:

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DEPARTMENT OF MECHANICAL ENGINEERING

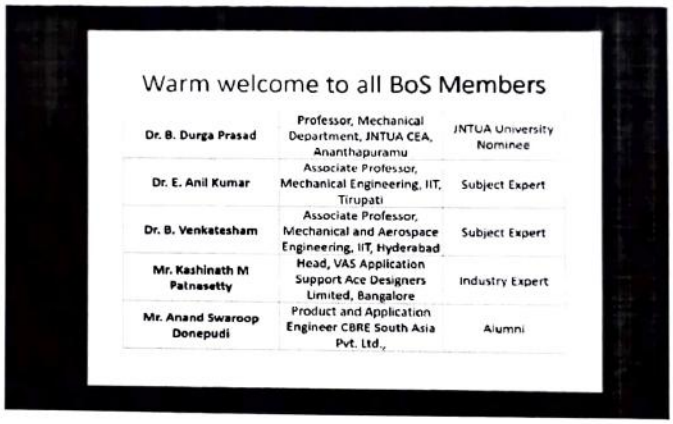
MADANAPALLE INSTITUTE OF TECHNOLOGY AND SCIENCE

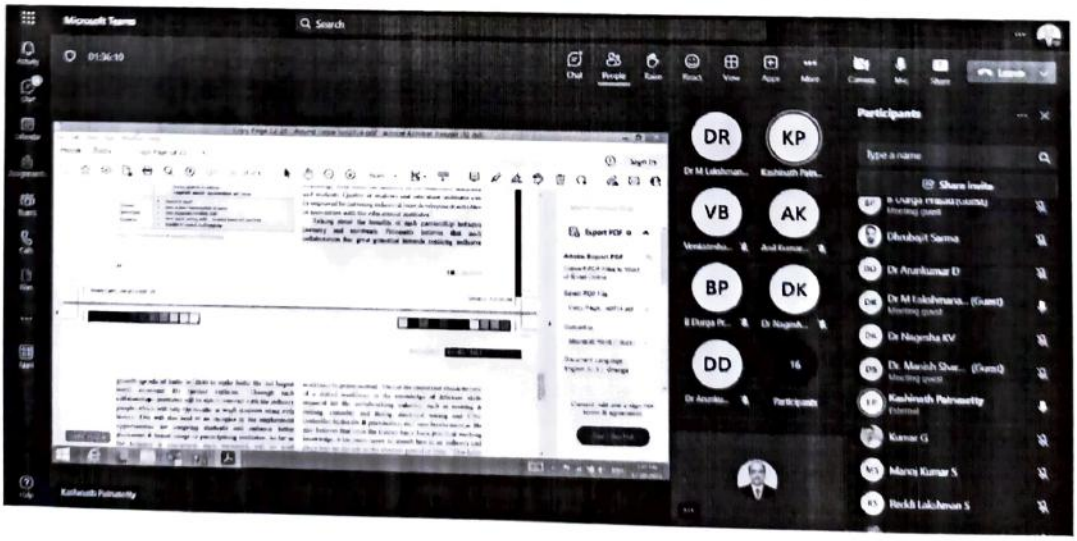
(An UGC Autonomous Institution)

Department of Mechanical Engineering

BOARD OF STUDIES (BOS) MEETING

17-JULY-2023





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DEPARTMENT OF MECHANICAL ENGINEERING

Approval:

The above-mentioned meeting minutes have been approved by the following members of the Board of Studies (BoS).

Sl. No.	Member Name	Designation	Signature
1.	**Dr. C. Yuvaraj**	Professor & Head of the Institution, MITS	
2.	**Dr. M. Lakshmana Rao** (BoS - Chairman)	Professor & Head of the Department, ME	
3.	**Dr. P. Ramanathan**	Vice Principal Academics, MITS	
4.	**Dr. B. Durga Prasad** (JNTUA University Nominee)	Professor, Mechanical Department, JNTUA CEA, Ananthapuramu.	Approval via email
5.	**Dr. E. Anil Kumar** (Subject Expert)	Professor, Mechanical Engineering, IIT, Tirupati.	Approval via email
6.	**Dr. B. Venkatesham** (Subject Expert)	Professor, Mechanical and Aerospace Engineering, IIT, Hyderabad.	Approval via email
7.	**Mr. Kashinath M Patnasetty** (Industry Expert)	Head, VAS Application Support Ace Designers Limited, Bangalore.	Approval via email
8.	**Mr. Anand Swaroop Donepudi** (Alumni)	Product and Application Engineer CBRE South Asia Pvt. Ltd.,	Approval via email
9.	**Dr. I. Arun**	Professor & Research Coordinator-ME	
10.	**Dr. S. Baskaran**	Assoc. Professor & IQAC Coordinator-MITS	
11.	**Dr. K. V. Nagesha**	Assoc. Professor & NBA Coordinator-ME	
12.	**Dr. P. Sivaiah**	Assoc. Professor & Workshop Incharge-ME	
13.	**Dr. R. Prithivi Rajan**	Assoc. Professor & Project Coordinator-ME	
14.	**Dr. Kamlesh Kumar**	Assistant Professor & Placement Coordinator-MITS	
15.	**Dr. Anantha Raman L**	Assistant Professor & Academic Coordinator-ME	

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DEPARTMENT OF MECHANICAL ENGINEERING

16.	**Dr. Arun Kumar.D**	Assistant Professor & IQAC Coordinator-ME	
17.	**Dr. Manish Sharma**	Assistant Professor & CO-PO Attainment Coordinator-ME	
18.	**Dr. Satyajit Pattanayak**	Assistant Professor & Placement Coordinator-ME	

Dr. M. Lakshmana Rao
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Dr. C. Yuvaraj
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Principal
Madanapalle Institute of
Technology & Science
MADANAPALLE

Copy to

- The Principal
- The Vice-Principal (Academics)
- BoS & Department file

MITS - ME - R20

PROFESSIONAL

ELECTIVE III

B.Tech. Mechanical Engineering

IV Year I Semester

20ME407 ENTREPRENEURSHIP AND PROJECT MANAGEMENT

L	T	P	C
3	0	0	3

Pre-requisite: None

Course description:

This course is designed to ignite the entrepreneurship idea into the young minds of engineers. This course gives the complete details to setup an enterprise which includes the generating business ideas, writing business plan and executing the plan successfully.

Course objectives:

1. Understand the requirements of entrepreneurship as a profession.
2. Understand and develop the business plan.
3. Identify the various financial terms and conditions of new business venture.
4. Selection of plant location and choosing layout.
5. Analyse the market research for new ventures and small businesses.

UNIT I | **INTRODUCTION** | **9 hours**

Introduction to Entrepreneurship, history of entrepreneurship development, social Entrepreneurship, Intrapreneurship, Definition of Entrepreneur, Entrepreneurial Traits, Entrepreneur vs. Manager, Entrepreneur vs Intrapreneur. The Entrepreneurial decision processes. Role of Entrepreneurship in Economic Development, Ethics and Social responsibility of Entrepreneurs. Opportunities for Entrepreneurs in India and abroad. Woman as Entrepreneur. Realities & Case studies about successful Entrepreneur.

UNIT II | **CREATING AND STARTING THE VENTURE** | **9 hours**

Sources of new Ideas, Methods of generating ideas. The Business Plan Nature and scope of Business plan, Writing Business Plan, Evaluating Business plans, implementation of business plans. Case studies of successful business plan, Marketing plan, financial plan, and organizational plan, Launching formalities. Developing business plan and evaluation with team.

UNIT III | **FINANCING AND MANAGING THE NEW VENTURE** | **9 hours**

Sources of capital, venture capital, angel investment, Record keeping, recruitment, motivating and leading teams, financial controls. Marketing and sales controls. Ecommerce and Entrepreneurship, Internet advertising. New venture Expansion Strategies and Issues, Features and evaluation of joint ventures, acquisitions, merges, franchising. Case studies about entrepreneur who success or failure in their business based on the financial control.

UNIT IV | **PLANT LAYOUT** | **9 hours**

Definition of plant layout and its types, Issues related to Selection of layout. Production and Marketing Management, Selection of production Techniques, plant utilization and maintenance. Case study about selection of site and plant layout for new business venture.

UNIT V | **MARKET ANALYSIS AND PROJECT MANAGEMENT** | **9 hours**

Inventory control, material handling and quality control. Marketing functions, market segmentation, market research and channels of distribution, Sales promotion and product pricing. Case studies on market analysis on entrepreneur perspective. Project Organization- Project Planning, Monitoring, Control and Learning. Detailed life cycle and post-mortem analysis, Resource allocation, Risk and uncertainty, Budget constraints, Project feasibility.

Course outcomes:

The students after completing the course will be able to:

1. Describe the sources of new business ideas, methods to develop new ideas and use the problem-solving techniques.
2. Write a business plan which includes financial plan, organizational plan and marketing plan.
3. Identify the financial sources for new business ventures.
4. Select a plant layout and draw a plant layout.
5. Design a workplace and analyse the market research for new business.

Text books:

1.Entrepreneurship, Robert Hisrich, & Michael Peters, 5/e TMH.
2. Entrepreneurship, Dollinger, Pearson, 4/e, 2004.

References:

1. Dynamics of Entrepreneurial Development and Management, Vasant Desai, Himalaya Publ. House, 2004.
2. Harvard Business Review on Entrepreneurship. HBR Paper Back, 1999.
3. Entrepreneurial Management, Robert J.Calvin, TMH, 2004.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B.Tech. Mechanical Engineering

IV Year I Semester

20ME408 Refrigeration and Air Conditioning

L	T	P	C
3	0	0	3

Pre-requisite: 20ME103

Course description:

Fundamental concepts of Refrigeration and Air Conditioning; Nomenclature of Refrigerants; Different Types of Refrigeration Systems; Psychrometric properties and processes; Different Types of Air Conditioning Systems; and Air Conditioning Equipment.

Course objectives:

1. To elucidate the fundamental concepts of Refrigeration and Vapour compression refrigeration system.
2. To explain the working of components in VCR system and to impart basics of refrigerants.
3. To explain the working of Vapour absorption refrigeration system and other refrigeration systems.
4. To elucidate the fundamental concepts of Air Conditioning and Air Conditioning Systems.
5. To explain the working of equipment in Air conditioning system and to introduce Comfort conditions and Heat pumps.

UNIT I | **INTRODUCTION TO REFRIGERATION AND VCR SYSTEM** | **9 hours**

Introduction to Refrigeration, Necessity and Applications, Unit of Refrigeration, COP, EER, Methods of refrigeration.

Vapour compression refrigeration system – Working principle, effect of sub cooling and super heating, ideal and actual cycle, multi-stage, cascading VCR systems, numerical problems.

UNIT II | **COMPONENTS OF VCR SYSTEM AND REFRIGERANTS** | **9 hours**

Vapour Compression Refrigeration System Components: General classification of compressors, condensers, evaporators and expansion devices and working principles.

Refrigerants: Desirable properties, Classification of refrigerants, Nomenclature, Environmental impact.

UNIT III | **VAR SYSTEM AND OTHER REFRIGERATION SYSTEMS** | **9 hours**

Vapour Absorption Refrigeration system: Introduction to Vapour absorption refrigeration system, Lithium-Bromide absorption refrigeration system, three fluid absorption refrigeration system and comparison of compression and absorption refrigeration systems.

Other Refrigeration systems: Working principles of Steam jet refrigeration system, Thermoelectric refrigeration system, Vortex & Pulse tube refrigeration system.

UNIT IV | **INTRODUCTION TO AIR CONDITIONING AND SYSTEMS** | **9 hours**

Psychrometric Properties & Processes, Characterization of Sensible and Latent Heat Loads, Need for Ventilation, Consideration of Infiltrated Air, Heat Load Concepts.

Air Conditioning Systems: Air Cooler (Evaporative Cooling), Window, Split, Summer, Winter, Year-Round, Central Air Conditioning Systems.

UNIT V | **AIR CONDITIONING EQUIPMENT** | **9 hours**

Air Conditioning Equipment: Humidifiers, Dehumidifiers, Air Filters, Fans and Blowers.

Human Comfort: Requirements of Temperature, Humidity and Concept of Effective Temperature, Comfort Chart. Heat Pump, Heat Sources, Different Heat Pump Circuits.

Course outcomes:

The students after completing the course will be able to:

1. Understand different methods of refrigeration and the applications.
2. Classify different types of refrigerants and their impact on the environment.
3. Understand the Vapour absorption refrigeration and other refrigeration systems.
4. Solve load calculations for air conditioning systems.
5. Understand the knowledge of different equipment used in Air conditioning systems.

Text books:

1. C. P. Arora, Refrigeration and Air Conditioning, TMH Publishers, New Delhi.
2. Domkundwar, Arora, Domkundwar A course in Refrigeration and Air Conditioning, Dhanpati Rai publications, New Delhi.

Data Book:

1. C P Kothandaraman, Refrigerant Tables and Charts, New Age International Publishers, Sixth Edition.
2. C P Kothandaraman, Steam Tables, New Age International Publishers, Fifth Edition.

References:

1. R.S. Khurmi, J.K. Gupta, Refrigeration and Air Conditioning, S. Chand publications.
2. Dossat, Principles of Refrigeration, Pearson Education, New Delhi.
3. Manohar Prasad, Refrigeration and Air Conditioning, NAI Publishers, New Delhi.
4. R.K. Rajput, Refrigeration and Air Conditioning, Kataria & Sons, New Delhi.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B.Tech. Mechanical Engineering

IV Year I Semester

20ME409 INTERNET OF MANUFACTURING THINGS

L	T	P	C
3	0	0	3

Pre-requisite: Basic knowledge on computers.

Course description:

The industrial sector is a key source of sustained income for contemporary society. To satisfy the needs of today's complex products, traditional manufacturing processes and related management strategies require ongoing evaluation and improvement. Internet of Things has Possibility to gather, process, analyze, and share real-time data while improving overall productivity within a predetermined time limit with greater flexibility and transparency. The goal of this course is to give students the skills they need to connect manufacturing and IoT systems.

Course objectives:

1. To impart fundamental understanding and the significance of IoT, as well as its logic and applications in the manufacturing sector.
2. To impart fundamental information about cloud computing and real-time information sensing in industrial systems.
3. Acquiring knowledge of the ideas behind IoT-enabled smart trolleys and assembly systems.
4. To give a fundamental grasp of scheduling software and methodologies for real-time production performance analysis.
5. To give a fundamental understanding of a system for information-driven, real-time production scheduling.

UNIT I	**Introduction**	**9 hours**

Concept of IoT, Existing manufacturing paradigms and their limitations, Applications of IoT in Manufacturing System (MS), The Concept of IoT-MS and its limitations. Overview of IoT-Enabled Manufacturing System: Overall architecture of IoT-MS, Integration framework of real-time manufacturing information.

UNIT II	**Real-Time (RT) Multisource Manufacturing Information Sensing System**	**9 hours**

Introduction, Overall Architecture of RT and multisource RMMISS, Deployment of multi-sensors, Multiple sensors manager, Multiple source manufacturing Information Capturing and Sharing, Case studies. Cloud Computing-Based Manufacturing – Introduction, Overall architecture, Cloud Machine Model, MS-UDDI, Task driven manufacturing service method

UNIT III	**IoT-Enabled Smart Assembly Station**	**9 hours**

Introduction, RFID based applications and assistant services in assembly line, Overall architecture, Real-time: Status Monitoring, Production Guiding, Data Sharing, Production Requeuing. IoT Enabled Smart Trolley– Material handling and real time strategy, RT-data capturing in manufacturing field, overall architecture, Real-time: Information capturing, Encapsulation, Workflow based guidance. Two stage combination optimization method.

UNIT IV	**Real-Time (RT) Production Performances Analysis Method**	**9 hours**

Real-time: Production monitoring technique, KPI analysis, Anomaly analysis. Overall architecture, even hierarchy of critical event, HTCPN analysis. Real time production anomaly diagnosis.

UNIT V	**Real-Time Information Driven Production Scheduling System**	**9 hours**

Introduction, RT production scheduling, Agent technology, Manufacturing information monitor technology, Overall architecture, Equipment agent, Capability evaluation agent model, RT- scheduling agent model, Production execution monitor agent model.

Course outcomes:

The focus of this course is to study the inculcation of IoT in manufacturing systems. By the end of the course student should:

1. Be able to understand the fundamentals of IoT and its application in manufacturing systems.
2. Have a clear overall picture of multisource manufacturing information sensing system and cloud manufacturing.
3. Outline various methods of IoT enabled smart assembly systems and summarize the usage of smart trolleys
4. Make use of various RT- production performance analysis methods for test its applicability to real life problems.
5. Make use of various RT- information driven production scheduling system for test its applicability to real life problems.

Text books:

1. Fei Tao, Y. Zhang, "Optimization of Manufacturing Systems Using the Internet of Things", 1st Edition, 2017, Academic Press, Elsevier.

References:

1. A. Gilchrist, "Industry 4.0: The Industry Internet of Things", 1st Edition, 2016, Apress.
2. M. Dastbaz, P. Cochrane, "Industry 4.0 and Engineering for a Sustainable Future", 1st Edition, 2019, Springer.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B.Tech. Mechanical Engineering

IV Year I Semester

20ME410 RENEWABLE ENERGY SYSTEMS

L	T	P	C
3	0	0	3

Pre-requisite: NIL

Course description:

The course delivers knowledge on fundamental concepts of Solar Energy, Biomass Energy, Wind Energy and Other Alternate Energy Sources.

Course objectives:

1.To facilitate the students to achieve a clear conceptual understanding of technical and commercial aspects of Wind, Solar, Biomass and Alternative Sources of Energy.
2.To enable the students to develop managerial skills to assess feasibility of alternative approaches and drive strategies regarding Wind, Solar, Biomass and Alternative Sources of Energy.

UNIT I **INTRODUCTION** **9 hours**

Global and national energy scenarios, concept of energy services, patterns of energy supply, energy resource availability, cultural, economic, and national security aspects of energy consumption, forms and characteristics of renewable energy sources, energy classification, source and utilization, thermodynamic power cycles and binary cycles.

UNIT II **SOLAR ENERGY & BIOMASS ENERGY** **9 hours**

Solar radiation, flat plate collectors, solar concentration, thermal applications of solar energy, photovoltaic technology and applications, energy storage.
Energy from biomass, thermo-chemical, biochemical conversion to fuels, biogas, and its applications.

UNIT III **WIND ENERGY** **9 hours**

Wind characteristics, resource assessment, horizontal and vertical axis wind turbines, electricity generation and water pumping, Micro/Mini hydropower system, water pumping and conversion to electricity, hydraulic pump.

UNIT IV **HYDROGEN & FUEL CELLS** **9 hours**

Introduction to Fuel cell Technology, Various types of fuel cell systems, Low & high temperature fuel cells, Fuel cell thermodynamics, Fuel cell efficiency.
Introduction to hydrogen economy, production, storage, and transportation systems, hydrogen from fossil fuels, transmission and infrastructure requirements, safety and environmental impacts, economics of transition to hydrogen systems.

UNIT V **OTHER RENEWABLE SOURCES** **9 hours**

Ocean thermal energy conversion, Geothermal, Tidal, Wave energy, MHD, environmental issues of energy sources.

Course outcomes:

After the completion of the course, the students will be able to:

1. Understand the fundamentals, availability, economics, and characteristics of the basic renewable energy sources.
2. Understand the fundamentals of solar energy and biomass energy.
3. Understand the fundamentals of wind energy.
4. Understand the fundamentals of hydrogen and fuel cells.
5. Understand the fundamentals of various renewable energy sources like geothermal, tidal, wave, etc.,

Text books

1.Rai, G.D., Non-Conventional Energy Sources, Khanna Publishers (2005).

2.Rao, S. and Parulekar, B.B., Energy Technology: Non-Conventional, Renewable and Conventional, Khanna Publishers (2005).

References:

1.Wadhwa, C.L., Generation, Distribution and Utilization of Electric Energy, New Age International (P) Limited, Publishers (2007).

2.Simon, Christopher A., Alternate Source of Energy, Rowman and Little Field Publishers Inc. (2007).

3.Venikov, V.A. and Putyatin, E.V., Introduction to Energy Technology, Mir Publishers (1990

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B.Tech. Mechanical Engineering

IV Year I Semester

20ME411 Nano Technology

L	T	P	C
3	0	0	3

Pre-requisite: 20ME104

Course description:

This course provides an introduction to the field of nanotechnology, which involves the study and application of materials and devices at the nanoscale. The course covers the basic principles of nanoscience, including the unique properties of materials at the nanoscale and their applications in various fields such as electronics, energy, medicine, and materials science. Topics covered in this course include the basic principles of quantum mechanics, nanofabrication techniques, characterization of nanomaterials.

Course objectives:

1. To enable the students to understand the science of nanomaterials
2. To enable students to understand properties of nanomaterials
3. To enable students to understand the different methods of synthesis of nonmaterial.
4. To enable students to understand the advanced Physical and Chemical methods of synthesis of nonmaterial.
5. To enable students to understand the instrumental techniques for characterization of nanomaterials

UNIT I	Background **to Nanoscience**	**9 hours**

Definition of Nano, Scientific Revolution-Atomic Structure and atomic size, emergence and challenges of nanoscience and nanotechnology, carbon age-new form of carbon (CNT to Graphene), influence of nano over micro/macro, size effects and crystals, large surface to volume ration, surface effects on the properties.

UNIT II	**Types of nanostructures, properties and Application of Nanomaterials:**	**9 hours**

One dimensional, Two dimensional and three-dimensional nanostructured materials, Quantum Dots shell structures, metal oxides, semiconductors, composites, mechanical-physical-chemical properties.

Applications: Ferroelectric materials, coating, molecular electronics and Nano electronics, biological and environmental, membrane-based application, polymer-based application.

UNIT III	Synthesis **and preparation of Nanomaterials**	**9 hours**

Synthesis of bulk nanostructured materials – Sol Gel processing- bulk and nano composite materials - Grinding - high energy ball milling –injection moulding - extrusion - melt quenching and annealing.

UNIT IV	**Nanomaterials** Synthetic **Technique** (Physical **and** Chemical)	**9 hours**

Self-Assembly-Self Assembled Monolayers (SAM) - Vapour Liquid Solid (VLS) approach - Chemical Vapour Deposition (CVD) - Langmuir-Blodgett (LB) films - Spin coating - Templated self-Assembly Electrochemical approaches: Thin films -Epitaxy -Lithography

UNIT V	**Nanomaterials Characterization** Techniques	**9 hours**

Surface Imaging: Scanning Electron Microscope (SEM) – Field Emission Scanning Electron Microscope (FESEM)-Atomic Force Microscopy (AFM), Scanning Tunnelling Microscopy (STM)– Transmission Electron Microscopy (TEM).

Course outcomes:

The students after completing the course will be able to:

1. Analyze the basic principles of quantum mechanics and their relevance to nanoscience.
2. Describe the fundamental principles of nanoscience, including the unique properties of nanomaterials and their applications in various fields.

3. Understand the different techniques used in the Synthesis and preparation of Nanomaterials.
4. Understand the different techniques used in the fabrication (Physical and Chemical) Technique of nanomaterials.
5. Understand the different techniques used in the characterization of nanomaterials

Text books:

1. Nanoparticles: From theory to applications – G. Schmidt, Wiley Weinheim 2004.
2. Instrument E L Principe, P Gnauck and P Hoffrogge, Microscopy and Microanalysis (2005), 11: 830- 831, Cambridge University Press.
3. Processing & properties of structural naonmaterials - Leon L. Shaw, C. Suryanarayana, Rajiv S. Mishra, Wiley, 2003.
4. D. K. Schroder, Semiconductor Material and Device Characterization, John Wiley & Sons, New York, 1998.

References:

1. Ghuzang G.Cao, Naostructures and Nanomaterials: Synthesis, properties and applications, Imperical College Press, 2004
2. Zhong Lin Wang, Hand Book of Nanophase & Nanostructured materials (Vol. I&II), Springer, 2002.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

MITS - ME - R20

PROFESSIONAL

ELECTIVE IV

B.Tech. Mechanical Engineering

IV Year I Semester

20ME412 Electric Vehicle Technology

L	T	P	C
3	0	0	3

Pre-requisite: NIL

Course description:

This course introduces the fundamental concepts, principles and analysis of Electric Vehicles and its accessories.

Course objectives:

1. To study the various aspects of EV technology.
2. To study and understand motors used for EV.
3. To understand the basic functionality of hybrid electric vehicle.
4. To study the various design of EV controllers.
5. To understand the storage, charging and safety in EV.

UNIT I | INTRODUCTION TO ELECTRIC VEHICLE — **9 hours**

A Brief History of EVs, Past, Present & Feature of EV, Current Major Issues, Recent Development Trends, EV Concept, Key EV Technology, State-of-the Art EVs & HEVs, Comparison of EV Vs IC Engine. EV Configuration: Fixed & variable gearing, single & multiple motor drive, In-wheel drives, EV Parameters: Weight, size, force, energy & performance parameters.

UNIT II | INTRODUCTION TO TRACTION MOTORS: — **9 hours**

Propulsion Machine Overview - DC Machines, AC Machines, Induction motor, Switched reluctance motor, Permanent Magnetic BLDC Motor Drives: Comparison of Traction Machines, A case study; Machine Specification - Four-Quadrant Operation, Rated Parameters, Rated Torque, Rated and Base Speeds, Rated Power, Peak Operation, Starting Torque; Characteristic Curves of a Machine - Constant-Torque Mode, Constant-Power Mode, Maximum-Speed Mode, Efficiency Maps.

UNIT III | HYBRID ELECTRIC VEHICLE — **9 hours**

Configuration of HEV (Series, Parallel, Series-parallel &Complex), Power Flow control, Examples. Power flow control in all HEV configurations, Examples of HEV system performance.

UNIT IV | FUNDAMENTALS OF EV CONTROLLERS — **9 hours**

Introduction to Control, Feedback Controller Design Approach, Modelling the Electromechanical System, The Mechanical System, The PM DC Machine, The DC-DC Power Converter, The PI Controller, Acceleration of Battery Electric Vehicle (BEV) using PM DC Machine, Acceleration of BEV using WF DC Machine.

UNIT V | STORAGE, CHARGING & SAFETY — **9 hours**

Different Batteries and Ultra capacitors; Battery characteristics (Discharging &Charging) Battery Chargers: Conductive (Basic charger circuits, Microprocessor based charger circuit. Arrangement of an off-board conductive charger, Standard power levels of conductive chargers, Inductive (Principle of inductive charging, Soft-switching power converter for inductive charging), Battery indication methods, Charging Infrastructure: Domestic Charging Infrastructure, Public Charging Infrastructure, Normal Charging Station, Occasional Charging Station, Fast Charging Station, Battery Swapping Station, Move-and-charge zone. Safety and Environment Aspects of EV Technology.

Course outcomes:

At the end of this course, students will be able to

1. Understand the various parameters involved in EV technology.
2. Classify and understand the motors used in EV.

3. Understand the application of Hybrid Electric Vehicle.
4. Interpret the design of EV controllers.
5. Execute the installation, storage, charging and safety in EV.

Text books:

1. John G. Hayes and A. Goodarzi, "Electric Powertrain - Energy Systems, Power electronics and drives for Hybrid, electric and fuel cell vehicles", Wiley Publication, 2018.
2. C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001

Data Book: NIL

References:

1. K Wang Hee Nam: AC Motor Control & Electrical Vehicle Application, CR Press, Taylor & Francis Group, 2019
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
3. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B.Tech. Mechanical Engineering

IV Year I Semester

20ME413 ADDITIVE MANUFACTURING

L	T	P	C
3	0	0	3

Pre-requisite: 20ME104, 20ME108

Course description:

This course introduces the fundamental concepts, principles and analysis of Battery Management System in Electric Vehicles Course.

Course objectives:

The main objective of this course is t:

1. Acquaint students with the concept of AM
2. Teach various AM technologies, post-processing
3. Teach Selection of AM parts, hybrid processes
4. Teach applications of AM in various fields.

UNIT I | **INTRODUCTION TO ADDITIVE MANUFACTURING** | **9 hours**

The Generic AM Process, Need for Additive Manufacturing, Benefits of AM, Distinction between AM and CNC machining and other related technologies, Development of Additive Manufacturing Technology, Classification of AM Process, Generalized Additive Manufacturing Process Chain, Advantages and Limitations of AM.

UNIT II | **EXTRUSION AND POWDER BED FUSION AM PROCESSES** | **9 hours**

Models and specifications, Process parameters, working principle, Applications, Advantages and Disadvantages of Vat Photopolymerization Processes, Stereolithography Apparatus (SLA), Solid ground curing (SGC). Laminated Object Manufacturing (LOM), Fused Deposition Modeling (FDM), Selective laser Sintering (SLS), Electron Beam melting (EBM).

UNIT III | **DIRECTED ENERGY DEPOSITION AM PROCESSES** | **9 hours**

Process Description, Material Delivery, Process parameters of Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Electron Beam Based Metal Deposition, Processing-structure-properties, relationships, Benefits and drawbacks, Applications of Directed Energy Deposition Processes. Functional effects and defects in AM.

UNIT IV | **POST PROCESSING OF AM PARTS AND PROCESS SELECTION** | **9 hours**

Post Processing of AM Parts: Support Material Removal, Surface Texture Improvement, Accuracy Improvement, Aesthetic Improvement, Preparation for use as a Pattern, Property Enhancements using Non-thermal and Thermal Techniques. Guidelines for Process Selection, Selection Methods for a Part, Challenges of Selection.

UNIT V | **TRENDS AND APPLICATIONS OF AM** | **9 hours**

Hybrid AM: Ultrasonic AM (UAM), Cold Spraying AM (CSAM), Friction stir AM (FSAM), Comparison between UAM, CSAM and FSAM.

AM Applications: Application of AM parts as Visualization Tools, Aerospace applications, Automotive applications, Medical Applications, Construction Industry and Retail applications.

Course outcomes:

At the end of this course, students will be able to

1. Understand the concept and importance of AM
2. Understand the working principle and process parameters of AM processes
3. Select the directed energy deposition AM process for the given application.
4. Perform and select suitable post-processing operations based on product repair requirement
5. Explore the trends and applications of AM processes in various fields

Text books:

1. Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing", 2nd Edition, Springer, 2015.
2. Chua Chee Kai, Leong Kah Fai, "3D Printing and Additive Manufacturing: Principles & Applications", 4th Edition, World Scientific, 2015.
3. Manu Srivastava, Sandeep Rathee, Sachin Maheshwari and T. K. Kundra, "Additive Manufacturing Fundamentals and Advancements", 1st edition, CRC Press, 2019.

Data Book: NIL

References:

1. Andreas Gebhardt, Understanding additive manufacturing: rapid prototyping, rapid tooling, rapid manufacturing, Hanser Publishers, 2011.
2. J.D. Majumdar and I. Manna, Laser-assisted fabrication of materials, Springer Series in Material Science, 2013.
3. L. Lu, J. Fuh and Y. S. Wong, Laser-induced materials and processes for rapid prototyping, Kluwer Academic Press, 2001.
4. Zhiqiang Fan and Frank Liou, Numerical modeling of the additive manufacturing (AM) processes of titanium alloy, InTech, 2012.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B.Tech. Mechanical Engineering

IV Year I Semester

20ME414 Fundamentals of Aerodynamics

L	T	P	C
3	0	0	3

Pre-requisite: 20ME105

Course description:

An introduction to aerodynamics including wing and airfoil theory, automobile aerodynamics and wind tunnel testing.

Course objectives:

- To understand the basics of fluid mechanics as a prerequisite to Aerodynamics
- Acquire knowledge on typical airfoil characteristics and two-dimensional flows over airfoil and study the incompressible over finite wings.
- Assimilate the understanding of application of aerodynamics on automobiles and wind tunnel testings.

UNIT I | Review of Basic Fluid Mechanics | 9 hours

Continuity, momentum and energy equation, Control volume approach to Continuity, momentum and energy equation, Types of flow, path lines, streamlines, and streak lines, units and dimensions, inviscid and viscous flows, compressibility, Mach number regimes. Vorticity, Angular velocity, Stream function, velocity potential function, Circulation, Mach cone and Mach angle, Speed of sound.

UNIT II | Airfoil Characteristics | 9 hours

Fundamental aerodynamic variables, Airfoil nomenclature, airfoil characteristics. wing planform geometry, aerodynamic forces and moments, centre of pressure, pressure coefficient, aerodynamic center, calculation of airfoil lift and drag from measured surface pressure distributions, typical airfoil aerodynamic characteristics at low speeds. Types of drag-Definitions.

UNIT III | Two Dimensional Flow over Airfoil | 9 hours

Two Dimensional Flows & Incompressible Flow Over Airfoil Uniform flow, Source flow, Sink flow, Combination of a uniform flow with source and sink. Doublet flow. Non-lifting flow over a circular cylinder. Vortex flow. Lifting flow over a circular cylinder.

UNIT IV | Introduction to Automobile Aerodynamics | 9 hours

Scope, historical developments, fundamental of fluid mechanics, flow phenomenon related to vehicles, external and Internal flow problem, resistance to vehicle motion, performance, fuel consumption and performance potential of vehicle aerodynamics, engine cooling requirement, air flow to passenger compartment, duct for air conditioning, cooling of transverse engine and rear engine.

UNIT V | Wind Tunnels for Automotive Aerodynamics | 9 hours

Introduction – Principles of wind tunnel technology – Limitation of simulation – Stress with scale models – Full scale wind tunnels – Measurement techniques – Equipment and transducers – Road testing methods.

Course outcomes:

The students after completing the course will be able to:

CO1: Understand the basic of fluid dynamics and its connectivity with aerodynamics.
CO2: Evaluate typical airfoil characteristics.
CO3: Evaluate two-dimensional flows over airfoil.
CO4: Understand the fundamentals of automobile aerodynamics.
CO5: Apply aerodynamics concepts in wind tunnel testing.

Textbooks:

1. Fundamental of Aerodynamics Anderson J D McGraw-Hill International Edition, New York 5th edition,2011.
2. Aerodynamics for Engineering Students E. L. Houghton, P.W. Carpenter Elsevier, New York 5th edition,2010
3. Hucho W.H., "Aerodynamics of Road vehicles", Butterworths Co. Ltd., 1987.
4. Pope, A., "Wind Tunnel Testing", John Wiley & Sons, 2nd Edt, New York, 1974.

Data Book:

NA

References:

1. Clancy L. J. "Aerodynamics", Sterling book house, New Delhi, 2006, ISBN: 9780582988804
2. Louis M. Milne-Thomson, "Theoretical Aerodynamics", Dover Publications-USA, Imported Edition,2011, ISBN 9780486619804.
3. Automotive Aerodynamics: Update SP-706, SAE, 1987.
4. Vehicle Aerodynamics, SP-1445, SAE, 1996.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations.

B.Tech. Mechanical Engineering

IV Year I Semester

20ME414 NON DESTRUCTIVE TESTING

L	T	P	C
3	0	0	3

Pre-requisite: Knowledge on welding process, casting of products, X ray techniques

Course description:

This course provides students a synopsis of non-destructive and destructive evaluation methods that are used in evaluation of welds. This includes understanding the basic principles of variousNDT methods, fundamentals, and discontinuities in different product forms, importance of NDT, applications, limitations of NDT methods and techniques and codes, standards and specifications related to non-destructive testing technology. Students also will be introduced to relevant quality assurance and quality control requirements in accordance with ASME, ASTM,AWS, BS, IBR standards

Course objectives:

1. To understand principle behind various NDT techniques.
2. To study about NDT equipment and accessories.
3. To learn working procedures of various NDT techniques.
4. To learn international inspection standards and specifications related to NDTtechniques.

UNIT I | SURFACE NON DESTRUCTIVE EVALUATION TECHNIQUES | 9 hours

Overview of the Non-Destructive Testing Methods for the detection of manufacturing defects. Liquid Penetrant Testing – Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials, Magnetization methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

UNIT II | CONVECTION HEAT TRANSFER | 9 hours

Thermography- Principles, Contact and non-contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation – infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation..

UNIT III | ULTRASONIC TESTING | 9 hours

Fundamentals of ultrasonic waves, Generation of ultrasonic waves-piezo electric effect, Ultrasonic inspection methods-pulse echo method, through transmission method, resonance method, Study of A, B and C scan presentations, Interpretation for welds, castings etc, applications, various case studies, Inspection standards and specifications (ASME, ASTM, AWS, BS, IBR etc.).

UNIT IV | RADIOGRAPHIC TESTING AND SAFETY | 9 hours

Basic principles of radiography- X rays and their properties, X ray generation, X ray absorption and scattering, Radiographic image-image formation and quality, image interpretation, radiography of weldments, Radiation safety- radiation detectors, radiation shielding. Interpretation for welds, castings etc, applications, various case studies, Inspection standards and specifications (ASME, ASTM, AWS, BS, IBR etc.)

UNIT V | ADVANCED NDE TECHNIQUES | 9 hours

Acoustic emission testing: Basic principle, parameters, Kaiser-Felicity theory Phased array techniques- Principles of phased array inspection, Theory and principles of time of flight diffraction (TOFD), Synthetic Aperture Focusing Technique (SAFT), Electro Magnetic

Acoustic Transducer (EMAT), Laser ultrasonics-Laser Shearographics, Structural health monitoring, Digital Radiography, Computed Tomography (CT).

Course outcomes:

The students after completing the course will be able to:

1. Know the different surface NDE techniques which enables to carry out various inspection
2. Perform inspection of samples and identify the defects using Theromgraphy and Eddycurrent testing
3. Understand basic knowledge of ultrasonic testing which enables them to perform inspectionof samples
4. Differentiate various defect types and characterize them using radiography
5. Understand the recent developments in NDE and their application in various industries

Text books:

1. Peter J. Shull "Non Destructive Evaluation: Theory, Techniques and Application" Marcel Dekker, Inc., New York, 2002.
2. Baldev raj, T Jeyakumar, M. Thavasimuthu "Practical Non-Destructive Tesitng" Narosa Publishing house, New Delhi, 2002.

References:

1. Baldev Raj and B.Venkataraman, "Practical Radiology", Narosa Publishing House, 2004.
2. Krautkramer.J, "Ultra Sonic Testing of Materials", 1st Edition, Springer – VerlagPublication, New York, 1996.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B.Tech. Mechanical Engineering

IV Year I Semester

20ME416 Total Quality Management

L	T	P	C
3	0	0	3

Pre-requisite: None

Course description:

Total quality management (TQM) is a philosophy, methodology and system of tools aimed to create and maintain mechanism of organization's continuous improvement. It involves all departments and employees for the improvement of processes and products. TQM encompasses various principles, techniques, and tools for identifying and solving problems, fostering a culture of quality, promoting teamwork, and striving for excellence in all areas of the organization. The goal of TQM is to achieve sustainable and long-term success by consistently delivering high-quality products and services that meet or exceed customer expectations while improving overall organizational performance.

Course objectives:

1. Study comprehensive knowledge about the principles, practices, tools and techniques of total quality management.
2. Gain knowledge on leadership, customer satisfaction, addressing customer complaints, team work, employee involvement, related to customer and supplier partnership.
3. Gather information on various tools and techniques, concept on Six Sigma, bench marking and Failure Mode Effective Analysis (FMEA).
4. Know the importance of Quality circle, Quality Function Deployment, Taguchi design and case studies related to TQM.
5. Facilitate the understanding of standards of quality.

UNIT I	INTRODUCTION	9 hours

Introduction - Evolution of Quality - Historical Perspective, Basic Concepts of Quality – Quality control, Quality management and Quality Assurance - Definition of TQM – Basic concepts of TQM - TQM Framework - Contributions by Deming, Juran, Crosby and Feigenbaum – Dimensions of product and service quality

UNIT II	TQM PRINCIPLES	9 hours

TQM principles - Strategic quality planning, Quality statements – Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention – Role of Leadership and Commitment in Quality Deployment, Team Building, Motivation and Rewards, Total Employee Empowerment, Performance appraisal - Continuous process improvement – Supplier partnership – Partnering, Supplier selection,

UNIT III	TOOLS OF TQM	9 hours

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – KAIZEN, 5S, JIT, Documentation – Failure mode and Effect Analysis (FMEA)

UNIT IV	TQM TECHNIQUES	9 hours

Quality circles – Quality Function Deployment (QFD) – House of Quality – Design of Experiments – Taguchi quality engineering – Orthogonal Arrays – Signal to Noise Ratio – TPM – Concepts, improvement needs – Cost of Quality – Performance measures –

UNIT V	IMPELMENTATION OF TQM	9 hours

Introduction – Benefits of ISO Registration – ISO 9000 Series of Standards –Implementation – Environmental Management System: Introduction – ISO 14000 Series Standards – Concepts of ISO 14001 – Requirements of ISO 14001, Case studies on TQM principles followed by Indian Industries.

Course outcomes:
The students after completing the course will be able to:
1. Understand the various principles and practices of TQM to achieve quality. 2. Identify the various statistical approaches for Total Quality Control. 3. Demonstrate the TQM tools for continuous process improvement. 4. Adopt the importance of ISO and Quality systems. 5. Make use of the concepts of TQM to solve case studies
Text books:
Dale H. Besterfield, et al., Total Quality Management, Pearson Education Asia, Third Edition, Indian Reprint (2003).
References:
1. James R. Evans and William M. Lindsay, The Management and Control of Quality, (6th Edition), South-Western (Thomson Learning), 2005. 2. Oakland, J.S. TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, Third Edition (2003). 3. Suganthi,L and Anand Samuel, Total Quality Management, Prentice Hall (India) Pvt. Ltd. (2006) Model.
Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

MITS - ME - R20

PROFESSIONAL ELECTIVE V

B.Tech. Mechanical Engineering

IV Year I Semester

20ME417 MECHANICAL VIBRATION

L	T	P	C
3	0	0	3

Pre-requisite: NIL

Course description:

An introduction to vibrations, damped vibrations, forced vibrations and instruments.

Course objectives:

- To understand the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.
- To understand the effect of Dynamics of undesirable vibrations.
- The student will be able to understand the sources of vibration in automobiles and make design modifications to reduce the vibration and improve the life of the components

UNIT I | **Introduction** | **9 hours**

Types of vibrations, Definitions, Simple Harmonic Motion (S.H.M.), Work done by harmonic force, Principle of super position applied to SHM, Beats, Fourier theorem and problems. Undamped (Single Degree of Freedom) Free Vibrations 9
Derivations for spring mass systems, Methods of Analysis, Natural frequencies of simple systems, Springs in series and parallel, Torsional and transverse vibrations, Effect of mass of spring and Problems.

UNIT II | **Damped free vibrations (1DOF)** | **9 hours**

Types of damping, Analysis with viscous damping - Derivations for over, critical and under damped systems, Logarithmic decrement and Problems.

UNIT III | **Multi degree freedom systems** | **9 hours**

Principle modes of vibrations, Normal mode and natural frequencies of systems (without damping) – Simple spring mass systems, masses on tightly stretched strings, double pendulum, torsional systems, combined rectilinear and angular systems, geared systems and Problems. Undamped dynamic vibration absorber and Problems.

UNIT IV | **Forced Vibrations (1DOF)** | **9 hours**

Introduction, Analysis of forced vibration with constant harmonic excitation - magnification factor, rotating and reciprocating unbalances, excitation of support (relative and absolute amplitudes), force and motion transmissibility, Energy dissipated due to damping and Problems.

UNIT V | **Vibration Measuring Instruments** | **9 hours**

Vibration Measuring Instruments and Whirling of shafts: Seismic Instruments, Vibrometers, Accelerometer, Frequency measuring instruments and Problems. Whirling of shafts with and without damping, discussion of speeds above and below critical speeds and Problems.

Course outcomes:

The students after completing the course will be able to:

CO1 Summarize the Basics of Vibration.
CO2 Summarize the Natural frequency of simple systems.
CO3 Explain the types of damping.
CO4 Discuss the forced vibration
CO5 Describe the various frequency measuring instruments.

Textbooks:

1. Singiresu S.Rao, "Mechanical Vibrations", 6th Edition, Pearson Education, 2016.

2. Theory of Vibrations with Applications 5th Edition, by William T. Thomson, Marie Dillon Dahlen, Chandramouli Padmanabhan (Author) , Perason.

Data Book:

NA

References:

1. Balakumar Balachandran and Edward B. Magrab, "Fundamentals of Vibrations", 1st Editon, Cengage Learning, 2009
2. Benson H. Tongue, "Principles of Vibrations", 2nd Edition, Oxford University, 2007
3. Grover G.T., "Mechanical Vibrations", Nem Chand and Bros., 2009

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B.Tech. Mechanical Engineering

IV Year I Semester

20ME418 Gas Dynamics and Jet Propulsion

L	T	P	C
3	0	0	3

Pre-requisite: 20ME103

Course description:

The goal of this course is to lay out the fundamental concepts and results for the compressible flow of gases. Topics to be covered include appropriate conservation laws; propagation of disturbances; isentropic flows; compressible flows in ducts with area changes, friction, or heat addition; heat transfer to high-speed flows; Principle of Jet propulsion and working of various propulsion devices.

Course objectives:

1. To derive the general expression for the velocity of an infinitesimal pressure disturbance in an arbitrary medium using the governing equations of fluid dynamics.
2. Starting with basic principles of continuity, energy, and momentum, derive expressions for property ratios in terms of Mach number and specific heat ratio for fanno flow with a perfect gas.
3. Sketch a normal shock process on a T-s diagram, indicating as many pertinent features as possible, such as static and total pressures, static and total temperatures, and velocities. Indicate each of the properties before and after the shock.
4. Analyze an oblique shock in a perfect gas and develop the relation among shock angle, deflection angle and entering Mach number.
5. To demonstrate principle of operation of Jet propulsion and working of various propulsion devices.

UNIT I	FUNDAMENTALS OF COMPRESSIBLE FLOW	9 hours

Introduction to compressible flow, second law of thermodynamics and entropy equation, acoustic velocity, Mach number and its significance, various flow regimes, Mach cone, Mach angle, Von Karman's rule of supersonic flow, concept of stagnation condition, relation between static an stagnation properties, entropy change in terms of stagnation properties, adiabatic energy equation, Prandtl velocity ellipse, critical speed of sound, stagnation speed of sound, maximum isentropic speed, reference Mach number, Crocco number, Stream thrust and the impulse function, dynamic pressure, flow compressibility factor, pressure coefficient of airfoil, steady one dimensional compressible flow of perfect gas.

UNIT II	ONE-DIMENSIONAL ISENTROPIC FLOW	9 hours

Isentropic process on Mollier diagram, flow expansion and compression, performance curves, effect of area variation, property ratios in terms of Mach number, area ratio in terms of Mach number, impulse function ratio, mass flux in terms of Mach number, mass flux in terms of pressure ratio, flow factor, Mach number and area ratio in terms of pressure ratio, use of gas tables and charts.

UNIT III	FANNO FLOW	9 hours

Governing equations for Fanno flow, Fanno line in Mollier diagram, effect of friction in subsonic and supersonic flows, limiting Mach number, effect of increase in flow resistance, effect of back pressure, Fanno relations for a perfect gas, temperature ratio, pressure ratio, density ratio, velocity ratio, stagnation pressure ratio, impulse function ratio, Change in entropy due to friction, friction coefficient, pressure drop due to friction, effect of friction on flow parameters, tables and charts for Fanno flow, Isothermal flow in Mollier diagram, flow parameter relations in isothermal flow, change in entropy, maximum length of duct, effect of friction in isothermal flow.

UNIT IV	RAYLEIGH FLOW	9 hours

Governing equations for Rayleigh flow, Rayleigh line in Mollier diagram, simple heating process, simple cooling process, Chocking in Rayleigh flow, state of maximum enthalpy, Mach number at maximum entropy and enthalpy, region between maximum enthalpy and entropy, Rayleigh relations for a pefect gas, pressure ratio, stagnation pressure ratio, temperature ratio, stagnation temperature ratio, density ratio, velocity ratio, change in entropy due to heat transfer, working tables and charts, choking due to heat transfer, maximum possible heat addition.

UNIT V	JET PROPULSION	9 hours

Principle of Operation – Classification of Jet Propulsive Engines – Working Principles with Schematic Diagrams and Representation on T-S Diagram - Thrust, Thrust Power and Propulsion Efficiency – Turbo Jet, Turbo Prop, Pulse Jet Engines – Schematic Diagram, Thermodynamic Cycle. Introduction to Rocket Propulsion.

Course outcomes:

The students after completing the course will be able to:

1. State the basic concepts of gas dynamics.
2. Write equations for the stagnation property in terms of static property, Mach number and ratio of specific heats.
3. Simplify the general equations of continuity, energy and momentum to obtain basic relations valid for any fluid in Fanno flow.
4. Sketch a Raleigh line in the p-v plane together with lines of constant entropy and constant temperature. Sketch a Rayleigh line in the h-s plane.
5. State the principle of operation of Jet propulsion and working of various propulsion devices.

Text books:

1. Pr. S L. Somasundaram, "Gas Dynamics and Jet Propulsions", New Age International Publishers.
2. S.Senthil, "Gas Dynamics and Jet Propulsion", A.R.S. Publicatons.

Databook:

1. Gas Tables for Compressible Flow, S M Yahya, New Age International Publishers.

References:

1. S.M. Yahya, "fundamentals of Compressible Flow", New Age International (P) Limited.
2. Anderson, J.D., "Modern Compressible flow", McGraw Hill.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B.Tech. Mechanical Engineering

IV Year I Semester

20ME419 Manufacturing of Composite Materials

L	T	P	C
3	0	0	3

Pre-requisite: 20ME104

Course description:

Composite material consists of both fiber and matrix. This course is designed to understand the composite materials applications, types of composite materials, phases, and various reinforcement and matrix. The various manufacturing techniques used of preparation of PMC, MMC & CMC are covered and gaining popularity over monolithic materials.

Course objectives:

1) To grasp the basic theory of composite materials and their importance.
2) To learn the different types of fibres used as reinforcements in composite material.
3) To impart knowledge on polymer composites and processing methods.
4) To understand the various matrix materials used as matrix in composite material.
5) To study the different type of manufacturing process for fabrication of ceramic composite materials.

UNIT I INTRODUCTION — **9 hours**

Introduction to Composites; Reinforcement and matrices; Types of reinforcements; Types of matrices; types of composites; Function of the Matrix and Reinforcement in Composites Matrices: Thermosets and Thermoplastic; Fibre Reinforcement; properties of composites in comparison with standard materials; applications of composites (metal, ceramics, and polymer matrix composites).

UNIT II MATRIX MATERIAL — **9 hours**

Matrix Materials – Polymers, glass transition temperature, thermoplastics and thermosets plastics, stress – strain behaviour, epoxy, polyester, Polyether ether ketone (PEEK), polypropylene (PP), matrix materials – metals: structure, strengthening methods, properties of metals (aluminium, titanium, magnesium), matrix materials – ceramics: bonding and structure, fracture toughness, properties of ceramics (glass, alumina, silicon carbide), fibre – matrix interface: wettability, surface roughness, mechanical bonding, chemical bonding.

UNIT III PROCESSING OF POLYMER MATRIX COMPOSITES (PMC) — **9 hours**

Thermoset matrix composites: hand layup, spray, filament winding, Pultrusion, resin transfer moulding, autoclave moulding - bag moulding, compression moulding – thermoplastic matrix composites – film stacking, diaphragm forming, thermoplastic tape laying, injection moulding – interfaces in PMCs – structure, properties and application of PMCs.

UNIT IV PROCESSING OF METAL MATRIX COMPOSITES (MMC) — **9 hours**

Metallic matrices: aluminium, titanium, magnesium, copper – processing of MMCs: liquid state, solid state, in – situ fabrication techniques – diffusion bonding – powder metallurgy techniques – Interfaces in MMCs – mechanical properties – machining of MMCs – Applications.

UNIT V PROCESSING OF CERAMIC MATRIX COMPOSITES (CMC) & Testing of Composites — **9 hours**

Processing of CMCs: cold pressing, sintering, reaction bonding, liquid infiltration, lanxide process – in situ chemical reaction techniques, chemical vapour deposition, chemical vapour impregnation, sol-gel – interfaces in CMCs – mechanical properties and applications of CMCs – applications.

Testing of Composites: Mechanical testing of composites, tensile testing, Compressive testing, Intra-laminar shear testing, Inter-laminar shear testing, Fracture testing etc.

Course outcomes:

The students after completing the course will be able to:

1.Classify the various matrix material and reinforcements for polymer matrix composites, MMC and ceramic matrix composites.
2.Developing the knowledge on processing, interfacial properties, and application of composites.
3.To get the thorough knowledge on manufacturing of polymer matrix composites.
4.Understanding the fabrication process of metal matrix composites.
5.Summarizing the various fabrication process of ceramic matrix composites.

Text books:

1.Krishan K. Chawla, "Composite Materials: Science and Engineering", Second edition. Springer-Verlag, Newyork, 2010.

Data Book: NIL

References:

1.Mallick P.K., Fiber Reinforced Composites: Materials, Manufacturing and Design, CRC press, New Delhi, 2010.
2.Sanjay K. Majumdar, "Composites manufacturing- materials, product, and process engineering" CRC Press, 2001.
3.B.D. Agrawal L.J. Broutman and K. Chandrashekhara "Analysis and Performance of Fiber Composites", John Wiley & Sons, 2006.
4. ASM Hand Book, " Composites", Vol.21, ASM International, 2001.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B.Tech. Mechanical Engineering

IV Year I Semester

20ME420 Power Plant Engineering

L	T	P	C
3	0	0	3

Course Description:

Introduction of power plants and their selection, steam power plant generators and accessories, their design and Environmental Aspects, Gas Turbine Power Plant, Solar and Wind based Power Generation, Economics of Power Generation

Course objectives:

- To study coal based thermal power plants.
- To study diesel, gas turbine and combined cycle power plants.
- To learn the basics of nuclear engineering and power plants.
- To learn the power from renewable energy
- To study energy, economic and environmental issues of power plants

UNIT I	COAL BASED THERMAL POWER PLANTS	9 hrs

Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.

UNIT II	DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS	9 hrs

Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimisation. Components of Diesel and Gas Turbine power, plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

UNIT III	NUCLEAR POWER PLANTS	9 hrs

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium- Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.

UNIT IV	POWER FROM RENEWABLE ENERGY	9 hrs

Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

UNIT V	ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS	9 hrs

Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.

Course outcomes (co):

At the end of the course the students would be able to:

1. Explain the layout, construction and working of the components inside a thermal power plant.
2. Explain the layout, construction and working of the components inside a Diesel, Gas and Combined cycle power plants.
3. Explain the layout, construction and working of the components inside nuclear power plants.
4. Explain the layout, construction and working of the components inside Renewable energy power plants
5. Explain the applications of power plants while extend their knowledge to power plant economics

Text books:

1. Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008.
2. A Textbook of Power Plant Engineeringby R.K. Rajput | 1 January 2016

References:

1. El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.
2. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 1998.
4. Power Plant Engineeringby B. Vijaya Ramnath C. Elanchezhian, L. Saravanakumar | 1 November 2019
5. Power Plant Engineering, As per AICTE: Theory and Practice by Dipak Kumar Mandal, Somnath Chakrabarti, et al. | 1 January 2019

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B.Tech. Mechanical Engineering

IV Year I Semester

20ME421 Operations Research

L	T	P	C
3	0	0	3

Course Description:

Operational Research (OR) is the application of similar ideas to larger, more complex decisions that concern the operations of systems, such as businesses and networks of machines. Making these decisions using OR entails employing mathematical methods in order to solve a numerical version of the problem at hand.

Course objectives:

The main learning objective of this course is to prepare the students for:

1. To learn Selecting the constraints on the availability of resources and developing a model and rendering an optimal solution for the given circumstances.
2. To study Appraising the challenges in the transportation and production problems and furnishing a rational solution to maximize the benefits.
3. To learn Planning the purchase/ manufacturing policies, managing the spares/ stocks and meeting the customer demands.
4. To Analysing the queue discipline and exploring the avenues for better customer service.
5. To Investigating the nature of the project and offering methodical assistance towards decision making in maintenance.

UNIT I **Introduction** **9 hrs**

Introduction: Evolution of OR, Definitions of OR, Scope of OR, Applications of OR, Phases in OR study. Characteristics and limitations of OR, models used in OR, Linear Programming Problem (LPP), Generalized LPP- Formulation of problems as L.P.P. Solutions to LPP by graphical method (Two Variables).

UNIT II **Linear** Programming **Problems** **9 hrs**

Simplex method, Canonical and Standard form of LP problem, slack, surplus and artificial variables, Solutions to LPP by Simplex method, Big-M Method and Two Phase Simplex Method, Degeneracy in LPP. Concept of Duality, writing Dual of given LPP. Solutions to L.P.P by Dual Simplex Method.

UNIT III **Transportation Problem** **9 hrs**

Formulation of transportation problem, types, initial basic feasible solution using North-West Corner rule, Vogel's Approximation method. Optimality in Transportation problem by Modified Distribution (MODI) method. Unbalanced T.P. Maximization T.P. Degeneracy in transportation problems, application of transportation problem. Assignment Problem-Formulation, Solutions to assignment problems by Hungarian method, Special cases in assignment problems, unbalanced, Maximization assignment problems. Travelling Salesman Problem (TSP). Difference between assignment and T.S.P, Finding best route by Little's method. Numerical Problems.

UNIT IV **Network analysis** **9 hrs**

Introduction, Construction of networks, Fulkerson's rule for numbering the nodes, AON and AOA diagrams; Critical path method to find the expected completion time of a project, determination of floats in networks, PERT networks, determining the probability of completing a project, predicting the completion time of project; Cost analysis in networks. Crashing of networks- Problems. Queuing Theory: Queuing systems and their characteristics, Pure-birth and Pure-death models (only equations), Kendall & Lee's notation of Queuing, empirical queuing models – Numerical on M/M/1 and M/M/C Queuing models.

UNIT V **Game Theory & Sequencing** **9 hrs**

Game Theory: Definition, Pure Strategy problems, Saddle point, Max-Min and Min-Max criteria, Principle of Dominance, Solution of games with Saddle point. Mixed Strategy problems. Solution of 2X2 games by Arithmetic method, Solution of 2Xn m and mX2 games by graphical method. Formulation of games. Sequencing: Basic assumptions, Johnson's algorithm, sequencing 'n' jobs on single machine using priority rules, sequencing using Johnson's rule-'n' jobs on 2 machines, 'n' jobs on 3 machines, 'n' jobs on 'm' machines. Sequencing of 2 jobs on 'm' machines using graphical method. Case studies of various automobile industries & their operation methodologies.

Course outcomes (co):

At the end of the course the students would be able to:

1. Understand the importance of unconstrained and constrained optimization to solve engineering problems.
2. Get an idea about the linear programming techniques.
3. Solve transportation and assignment problems in engineering situations.
4. Analyze the problems of network analysis for project management and Queuing systems engineering & industry.
5. Get an idea about the game theory & sequencing.

Text books:

1. Operations Research, P K Gupta and D S Hira, S. Chand and Company LTD. Publications, New Delhi – 2007
2. Operations Research, An Introduction, Seventh Edition, Hamdy A. Taha, PHI Private Limited, 2006.J K Sharma,
3.Operations Research: Theory and Practice, Macmillan Publishers India Ltd, 5th edition,2013. B.S. Grewal, Higher Engineering Mathematics, 43rd edition (2014), Khanna publishers. Reference Books 1. Hamdy A Taha,
4.Operations Research: An Introduction, Pearson Education, 9/E, 2011. 2. FS Hillier and GJ Lieberman, Introduction to Operations Research, TMH, 8/E, 2006. 3. JC Pant,
5. Introduction to Optimization: Operations Research, Jain Brothers, New, 6/E, 2004. 4. A Ravindran, DT Philips and JJ Solberg.

References:

1. Operations Research, Theory and Applications, Sixth Edition, J K Sharma, Trinity Press, Laxmi Publications Pvt. Ltd. 2016.
2. Operations Research, Paneerselvan, PHI 3. Operations Research, A M Natarajan, P Balasubramani, Pearson Education, 2005 4. Introduction to Operations Research, Hillier and Lieberman, 8th Ed., McGraw Hill

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

MITS - ME - R20

SKILL ORIENTED COURSE V

B.Tech. Mechanical Engineering

IV Year I Semester

20ME604 Advanced Manufacturing Technologies
(Skill Oriented Course)

L	T	P	C
1	0	2	2

Pre-requisite: 20ME108, 20ME205, 20ME208, 20ME212

Course description:

This course gives hands on experience on various advanced manufacturing techniques and characterization equipment using CNC lathe machine, CNC milling machine, CNC lathe machine, Electrical Discharge Machining machine, Pin on disc tribometer, 3D Printing, optical microscope and surface roughness tester.

Course objectives:

1. To gain the knowledge and hands on experience for writing and operating of programs for CNC machines.
2. To gain knowledge and hands-on experience in EDM machine and Tribometer.
3. To learn knowledge and hands on experience on coding and operation of 3D printer
4. To have hands on experience on various characterization equipment namely optical microscope and surface roughness tester.

Units:

1) CNC lathe Machine: Introduction of CNC lathe (Use G and M codes)

a) Programming for plain turning – facing, center drilling
b) Programming of step turning
c) Programming for step, taper and undercut process.
d) Programming for threading turning process.

2) CNC Milling machine: Introduction to CNC Milling Machine (Use G code and M code)

a) Programming for up and down milling.
b) Programming taper milling.
c) Programming for end milling.
d) Programming for profile milling

3) Electrical Discharge Machining & Pin on Disc Tribometer

a) Electric discharge performance study on Material Removal Rate (MRR)
b) Study on effect of powder mixed Electrical Discharge Machining process and surface properties.
c) Study of Pin on Disc Tribometer for Wear Measurement.
d) Identification of wear rate for various Loading Condition.
e) Analysis of velocity and its influence on velocity.
f) Wear rate variation under various environmental conditions.

4) 3D Printing

a) Introduction to 3D printing, its historical development, advantages.
b) Classification of 3D printing process.
c) Process chain, 3D modelling, Data Conversion, and transmission.
d) Part orientation and printing.
e) Support structure generation.
f) Types of fills while printing.
g) Post processing of printed components.

5) Optical microscope and surface roughness tester.

a) Surface roughness measurement and surface defect analysis of turned and milled products using optical microscope using surface roughness tester.

b) Measurement of tool wear and identification of tool wear mechanisms using optical microscope.

Course outcomes:

At the end of the course, students can:

1. Execute part programs for lathe and milling operations.
2. Operate CNC machines and manufacture products.
3. Operate EDM machine and manufacture products.
4. Perform wear analysis using Pin on Disc Tribometer.
5. Operate 3D printing machine and manufacture products.
6. Measure tool wear and surface roughness using Optical microscope and surface roughness tester respectively.

Text books:

1. Lab manual provided by the Department.
2. Computer Control of Manufacturing Systems, Yoram Koren.
3. Electrical Discharge Machining (EDM): Types, Technologies & Applications, Dr. Jahan MP.
4. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Ian Gibson, David Rosen, Brent Stucker.

References:

1. Serope Kalpakjian, Steven R. Schmid (2018) Manufacturing Engineering and Technology (7th Edition) By Pearson.

Mode of Evaluation: Continuous Internal Evaluation and End Semester Examination.

MITS - ME - R20

OPEN ELECTIVE IV

B.Tech. Mechanical Engineering

IV Year I Semester

20ME304 Total Quality Management

L	T	P	C
3	0	0	3

Pre-requisite: None

Course description:

Total quality management (TQM) is a philosophy, methodology and system of tools aimed to create and maintain mechanism of organization's continuous improvement. It involves all departments and employees for the improvement of processes and products. TQM encompasses various principles, techniques, and tools for identifying and solving problems, fostering a culture of quality, promoting teamwork, and striving for excellence in all areas of the organization. The goal of TQM is to achieve sustainable and long-term success by consistently delivering high-quality products and services that meet or exceed customer expectations while improving overall organizational performance.

Course objectives:

1. Study comprehensive knowledge about the principles, practices, tools and techniques of total quality management.
2. Gain knowledge on leadership, customer satisfaction, addressing customer complaints, team work, employee involvement, related to customer and supplier partnership.
3. Gather information on various tools and techniques, concept on Six Sigma, bench marking and Failure Mode Effective Analysis (FMEA).
4. Know the importance of Quality circle, Quality Function Deployment, Taguchi design and case studies related to TQM.
5. Facilitate the understanding of standards of quality.

UNIT I	INTRODUCTION	9 hours

Introduction - Evolution of Quality - Historical Perspective, Basic Concepts of Quality – Quality control, Quality management and Quality Assurance - Definition of TQM – Basic concepts of TQM - TQM Framework - Contributions by Deming, Juran, Crosby and Feigenbaum – Dimensions of product and service quality

UNIT II	TQM PRINCIPLES	9 hours

TQM principles - Strategic quality planning, Quality statements – Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention – Role of Leadership and Commitment in Quality Deployment, Team Building, Motivation and Rewards, Total Employee Empowerment, Performance appraisal - Continuous process improvement – Supplier partnership – Partnering, Supplier selection,

UNIT III	TOOLS OF TQM	9 hours

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – KAIZEN, 5S, JIT, Documentation – Failure mode and Effect Analysis (FMEA)

UNIT IV	TQM TECHNIQUES	9 hours

Quality circles – Quality Function Deployment (QFD) – House of Quality – Design of Experiments – Taguchi quality engineering – Orthogonal Arrays – Signal to Noise Ratio – TPM – Concepts, improvement needs – Cost of Quality – Performance measures –

UNIT V	IMPELMENTATION OF TQM	9 hours

Introduction – Benefits of ISO Registration – ISO 9000 Series of Standards –Implementation – Environmental Management System: Introduction – ISO 14000 Series Standards – Concepts of ISO 14001 – Requirements of ISO 14001, Case studies on TQM principles followed by Indian Industries.

Course outcomes:

The students after completing the course will be able to:

1. Understand the various principles and practices of TQM to achieve quality.
2. Identify the various statistical approaches for Total Quality Control.
3. Demonstrate the TQM tools for continuous process improvement.
4. Adopt the importance of ISO and Quality systems.
5. Make use of the concepts of TQM to solve case studies

Text books:

Dale H. Besterfield, et al., Total Quality Management, Pearson Education Asia, Third Edition, Indian Reprint (2003).

References:

1. James R. Evans and William M. Lindsay, The Management and Control of Quality, (6th Edition). South-Western (Thomson Learning), 2005.
2. Oakland, J.S. TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, Third Edition (2003).
3. Suganthi,L and Anand Samuel, Total Quality Management, Prentice Hall (India) Pvt. Ltd. (2006) Model.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B.Tech. Mechanical Engineering

IV Year I Semester

20ME305 ENTREPRENEURSHIP

L	T	P	C
3	0	0	3

Pre-requisite: None

Course description:

This course is designed to ignite the entrepreneurship idea into the young minds of engineers. This course gives the complete details to setup an enterprise which includes the generating business ideas, writing business plan and executing the plan successfully.

Course objectives:

1. Understand the requirements of entrepreneurship as a profession.
2. Understand and develop the business plan.
3. Identify the various financial terms and conditions of new business venture.
4. Selection of plant location and choosing layout.
5. Analyse the market research for new ventures and small businesses.

UNIT I INTRODUCTION — **9 hours**

Introduction to Entrepreneurship, history of entrepreneurship development, social Entrepreneurship, Intrapreneurship, Definition of Entrepreneur, Entrepreneurial Traits, Entrepreneur vs. Manager, Entrepreneur vs Intrapreneur. The Entrepreneurial decision processes. Role of Entrepreneurship in Economic Development, Ethics and Social responsibility of Entrepreneurs. Opportunities for Entrepreneurs in India and abroad. Woman as Entrepreneur. Realities & Case studies about successful Entrepreneur.

UNIT II CREATING AND STARTING THE VENTURE — **9 hours**

Sources of new Ideas, Methods of generating ideas. The Business Plan Nature and scope of Business plan, Writing Business Plan, Evaluating Business plans, implementation of business plans. Case studies of successful business plan, Marketing plan, financial plan, and organizational plan, Launching formalities. Developing business plan and evaluation with team.

UNIT III FINANCING AND MANAGING THE NEW VENTURE — **9 hours**

Sources of capital, venture capital, angel investment, Record keeping, recruitment, motivating and leading teams, financial controls. Marketing and sales controls. Ecommerce and Entrepreneurship, Internet advertising. New venture Expansion Strategies and Issues, Features and evaluation of joint ventures, acquisitions, merges, franchising. Case studies about entrepreneur who success or failure in their business based on the financial control.

UNIT IV PLANT LAYOUT — **9 hours**

Definition of plant layout and its types, Issues related to Selection of layout. Production and Marketing Management, Selection of production Techniques, plant utilization and maintenance. Case study about selection of site and plant layout for new business venture.

UNIT V MARKET ANALYSIS AND PROJECT MANAGEMENT — **9 hours**

Inventory control, material handling and quality control. Marketing functions, market segmentation, market research and channels of distribution, Sales promotion and product pricing. Case studies on market analysis on entrepreneur perspective. Project Organization- Project Planning, Monitoring, Control and Learning. Detailed life cycle and post-mortem analysis, Resource allocation, Risk and uncertainty, Budget constraints, Project feasibility.

Course outcomes:

The students after completing the course will be able to:

1. Describe the sources of new business ideas, methods to develop new ideas and use the problem-solving techniques. 2. Write a business plan which includes financial plan, organizational plan and marketing plan. 3. Identify the financial sources for new business ventures. 4. Select a plant layout and draw a plant layout. 5. Design a workplace and analyse the market research for new business.
Text books:
1.Entrepreneurship, Robert Hisrich, & Michael Peters, 5/e TMH. 2. Entrepreneurship, Dollinger, Pearson, 4/e, 2004.
References:
1. Dynamics of Entrepreneurial Development and Management, Vasant Desai, Himalaya Publ. House, 2004. 2. Harvard Business Review on Entrepreneurship. HBR Paper Back, 1999. 3. Entrepreneurial Management, Robert J.Calvin, TMH, 2004.
Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

MITS - ME - R20

HONORS

B.Tech. Mechanical Engineering				
Honors				
20HDME102 Design and Analysis of Welded Structures				
	L	T	P	C
	3	0	0	3
Course description:				
This course presents the concepts behind welding and joining technology. The concepts are then applied to the design and fabrication of engineering components, process plant and structures. The importance of selecting the correct welding design, size and parameters for a particular application will be demonstrated. At the end of the course students should have the concepts to assist in the selection of processes and parameters to make appropriately designed, sound joints, fit for service in the operating environment.				
Course objectives:				
1.To elucidate the fundamental purpose of welded structures 2. To understand the theory of weld structures and design considerations 3. To understand the weld joints design under static and dynamic loading conditions. 4. To train the students in selecting, determining and estimating the weld structure, size and cost respectively. 5. To identify the weld defects and understand the weld quality inspection methods				
UNIT I	**Design for Purpose of Welded Structures**			**9 hours**
Introduction to design for purpose concepts for welded structures-Post- weld treatment methods for welded structures-Design considerations for manual and automated welding processes				
UNIT II	**Design of Welded Structures**			**9 hours**
Basic theory of structural systems- Loads on structures-Introduction to the design of structures-Analysis methods for structures-Design guidance documents, codes and standards				
UNIT III	**Design of Welded Joints-I**			**9 hours**
Categories of welded joints-Design of welded joints with predominantly static loading-Design of welded joints with predominantly dynamic/cyclic loading-Design against brittle fracture				
UNIT IV	**Design of Welded Joints-II**			**9 hours**
Selection of Structural Steel for Welded Construction-Weldability and Welding procedure-Joint Design-Determining weld size-estimating welding cost-welding on existing structures				
UNIT V	**Welding Fabrication**			**9 hours**
Control of Shrinkage and Distortion- painting & corrosion of welded structures-weld quality Inspection methods and criteria- Quality assurance in welding fabrication				
Course outcomes:				
The students after completing the course will be able to: 1. Demonstrable knowledge of a range of welding structures and the considerations to select an appropriate welding process for a particular application 2. Analytical methods for understanding the design of structures 3. Recognize the importance of impact of static and dynamic loading conditions 4. Apply the concepts of determining and estimating the weld size and cost respectively. 5. Explain the effects of welding defects and inspection methods.				
Text books:				
1. Design of Welded Structures by Orner W Blodgentt, The James F Lincoln arc welding foundation 2. International Welded Structures Designer by Av. Prof. Dr. Cavaco Silva				
Data Book:				

1. International Welded Structures Designer, Prepared and issued by the IAB-International Authorisation Board Under the authority of the IIW-International Institute of Welding.

References:

1. Welding Metallurgy, IIT Roorkee, Dr. Pradeep K. Jha
2. Welding Engineering, IIT Roorkee.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B.Tech. Mechanical Engineering

Honors

20HDME105 Solar Energy for Process Heat and Power Generation

L	T	P	C
3	0	0	3

Course description:

To study fundamentals and application of solar thermal systems for heating, cooling, power generation and other applications.

Course objectives:

1. The knowledge on solar passive heating and cooling.
2. The fundamentals of design calculations and analysis of solar thermal systems.
3. The functioning and design of solar thermal cooling systems.
4. The basics of solar thermal technology for process heating applications.
5. The fundamentals of design calculations and economics of solar power generation.

UNIT I **ENERGY RESOURCES AND SOLAR SPECTRUM** **9 hours**

World energy resources - Indian energy scenario - Environmental aspects of energy utilization. Renewable energy resources and their importance - Global solar resources. Solar spectrum – Electromagnetic spectrum, basic laws of radiation. Physics of the Sun - Energy balance of the earth, energy flux, solar constant for earth, greenhouse effect.

UNIT II **SOLAR THERMAL ENERGY CONVERSION** **9 hours**

Thermodynamic cycles – Carnot – Organic, reheat, regeneration and supercritical Rankine cycles - Brayton cycle – Stirling cycle – Binary cycles – Combined cycles. Solar thermal power plants - Parabolic trough system, distributed collector, hybrid solar-gas power plants, solar pond based electric-power plant, central tower receiver power plant.

UNIT III **APPLICATIONS OF SOLAR COLLECTORS** **9 hours**

Application of non-concentrating collectors in low temperature solar thermal plants for space heating and cooling, drying, seawater desalination. Use of concentrating collectors for process heat production and power generation.

UNIT IV **SOLAR PASSIVE HEATING AND COOLING** **9 hours**

Thermal comfort - Heat transmission in buildings - Bioclimatic classification. Passive heating concepts - Direct heat gain, indirect heat gain, isolated gain and sunspaces. Passive cooling concepts - Evaporative cooling, radiative cooling, application of wind, water and earth for cooling, roof cooling, earth air-tunnel. Energy efficient landscape design - Concept of solair temperature and its significance, calculation of instantaneous heat gain through building envelope

UNIT V **SOLAR THERMAL APPLICATIONS AND POWER PLANTS** **9 hours**

Solar systems for process heat production - Solar cooking – Performance and testing of solar cookers. Seawater desalination – Methods, solar still and performance calculations. Solar pond - Solar greenhouse. Solar thermal electric power plants based on parabolic trough, solar central receiver, parabolic dish-Stirling engine. Concentrated solar power using Fresnel lenses. Fundamentals of design calculations and analysis of solar power plants. Economic analysis

Course outcomes:

The students after completing the course will be able to:

1. Apply heat conduction equations to different surface configurations under steady state and transient conditions and solve problems
2. Apply free and forced convective heat transfer correlations to internal and external flows through/over various surface configurations and solve problems
3. Explain the phenomena of boiling and condensation, apply LMTD and NTU methods of thermal analysis to different types of heat exchanger configurations and solve problems

4. Explain basic laws for radiation and apply these principles to radiative heat transfer between different types of surfaces to solve problems
5. Apply diffusive and convective mass transfer equations and correlations to solve problems for different applications

References:

1. Kalogirou .S.A., "Solar Energy Engineering: Processes and Systems", Academic Press, 2009.
2. Vogel. W, Kalb .H, "Large-Scale Solar Thermal Power Technologies", WileyVCH, 2010. 3. Duffie .J. A, Beckman .W. A, "Solar Engineering of Thermal Process", Wiley, 3rd ed. 2006.
4. Khartchenko .N.V, "Green Power: Eco-Friendly Energy Engineering", Tech Books, Delhi, 2004.
5. Goswami .D.Y, Kreith .F, Kreider .J.F, "Principles of Solar Engineering", 2nd ed., Taylor and Francis, 2000, Indian reprint, 2003.
6. Garg .H.P, Prakash .J, "Solar Energy Fundamentals and Applications", Tata McGraw-Hill, 2005.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B.Tech. Mechanical Engineering

Honors

20HDME107 Powder Metallurgy

L	T	P	C
3	0	0	3

Course Description:

Introduction of sheet metal forming processes involved in the powder forming processes and classification of forming processes.

Course objectives:

- Describing types of deformations and classification of forming processes.
- Classifying and explaining bulk forming processes.
- Describing sheet metal forming processes
- Distinguishing differences between conventional forming and special forming processes.
- Elaborating various stages involved in the powder forming processes.

UNIT I | **Introduction** | **9 hrs**

Mechanical behavior of materials- Elastic and plastic deformations - Classification of forming processes - Temperature in metal working: Cold, Warm, and hot working - Introduction to the theory of plastic deformation.

UNIT II | **BULK FORMING** | **9 hrs**

Introduction - Plastic deformation in forging, rolling, extrusion, rod/wire, tube drawing and swaging processes and their applications - Effect of friction, calculation of forces, work done, process parameters, equipment's, and defects - Design for manufacturing - Economics of bulk forming.

UNIT III | **SHEET METAL FORMING** | **9 hrs**

Introduction - Sheet metal characteristics - Conventional sheet metal forming processes like shearing, bending and miscellaneous forming processes - High energy rate forming processes - Super plastic forming processes - Deep drawing process - Principles, process parameters, advantages, limitations, and applications of the above - Formability of sheet metals - Equipment's - Defects - Design for manufacturing - Economics of sheet metal forming.

UNIT IV | **SPECIAL FORMING** | **9 hrs**

Orbital forging - Isothermal forging - Hot and cold Isostatic pressing - High speed extrusion - High-speed forming machines - Rubber pad forming - Water hammer forming - Fine blanking - Incremental forming and comparing the above with conventional forming.

UNIT V | **POWDER FORMING** | **9 hrs**

Introduction - Powder production methods - Particle size characterization – Blending – Compacting - Sintering - Secondary and finishing operations - Advantages and applications of powder metallurgy - Design for manufacturing - Powder forging, rolling, extrusion, drawing - Economics of powder forging.

Course outcomes (co):

Upon completion of this course, the students will be able to:
1. Illustrate deformation types and classification of forming processes.
2. Describe bulk forming processes and their applications.
3. Elaborate different sheet metal forming processes and their applications.
4. Compare and distinguish conventional and special forming processes.
5. Discuss powder forming processes and its applications

Text books:

1. Kalpakjian S. and Schmid S.R., "Manufacturing Engineering and Technology", Pearson., New Delhi, India, 2018.

2. Sadhu Singh, "Theory of plasticity and metal forming processes", Khanna Publishers, 2008

References:

1. Heinz Tschatsch, "Metal Forming Practise: Processes - Machines – Tools", Springer-Verlag Berlin Heidelberg., Germany, 2006. 2. Juneja B.L., "Fundamentals of Metal forming Processes", New Age International Publishers Ltd., Chennai, India, 2018. 3. Kumar Surender, "Technology of Metal Forming Processes", PHI learning Pvt. Ltd., New Delhi, India, 2008. 4. Nagpal G.R.,"Metal Forming Processes", Khanna Publishers., New Delhi, India, 2000. 5. Mikell P. Groover, "Fundamental of Modern Manufacturing: Materials, Processes and Systems", John Wiley and Sons Ltd., United States, 2013

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B.Tech. Mechanical Engineering

Honors

20HDME108 Advanced Fluid Mechanics

L	T	P	C
3	0	0	3

Course description:

The subject deals with the static, kinematics and dynamic aspects of fluids. The study of fluids at rest is called fluid statics. The study of fluid in motion is called fluid kinematics if pressure forces are not considered if pressure force is considered in fluid in motion is called fluid dynamics.

Course objectives:

- To understand the laws of fluid flow for ideal and viscous fluids.
- To represent the real solid shapes by suitable flow patterns and to analyze the same for aerodynamics performances.
- To understand the changes in properties in compressible flow and shock expansion.

UNIT I | **BASIC EQUATIONS OF FLOW** | **9 hours**

Three dimensional continuity equation - differential and integral forms – equations of motion momentum and energy - Reynolds transport theorem – Navier – Stokes equation – Engineering Applications

UNIT II | **POTENTIAL FLOW THEORY** | **9 hours**

Rotational and irrorational flows - circulation – vorticity - stream and potential functions for standard flows and combined flows – representation of solid bodies by flow patters. Pressure distribution over stationery and rotating cylinders in a uniform flow - magnus effect - Kutta –Zhukovsky theorem. Complex potential functions. Conformal transformation to analyze the flow over flat plate, cylinder, oval body and airfoils. Thin airfoil theory – generalized airfoil theory for cambered and flapped airfoils.

UNIT III | **VISCOUS FLOW THEORY** | **9 hours**

Laminar and turbulent flow - laminar flow between parallel plates - Poiseuille's equation for flow through circular pipes. Turbulent flow - Darcy Weisbach equation for flow through circular pipe - friction factor - smooth and rough pipes - Moody diagram – losses during flow through pipes. Pipes in series and parallel – transmission of power through pipes.

UNIT IV | **BOUNDARY LAYER CONCEPT** | **9 hours**

Boundary Layer - displacement and momentum thickness - laminar and turbulent boundary layers in flat plates - velocity distribution in turbulent flows in smooth and rough boundaries - laminar sub layer.

UNIT V | **COMPRESSIBLE FLUID FLOW** | **9 hours**

One dimensional compressible fluid flow – flow through variable area passage – nozzles and diffusers – fundamentals of supersonics – normal and oblique shock waves and calculation of flow and fluid properties over solid bodies (like flat plate, wedge, diamond) using gas tables

Course outcomes:

The students after completing the course will be able to:

1. familiarized about the ideal and viscous fluid flow
2. familiarized about the boundary layer concepts
3. familiarized about the changes in properties in compressible flow
4. familiarized about the boundary layer concept and shock expansion
5. familiarized about the compressible fluid flow.

Textbooks:

1. Anderson J.D., Fundamentals of Aerodynamics, McGraw Hill, Boston, 2001.
2. Bansal R.K., Fluid Mechanics, Saurabh and Co., New Delhi, 1985

3. Houghten E.L. and Carruthers N.B., Aerodynamics for Engineering Students, Arnold Publishers, 1993.

References:

1. Kumar K.L., Engineering Fluid Mechanics, Eurasia Publishing House, New Delhi, 2002.
2. Munson B.R., Young D.F. and Okiisi, T.H., Fundamentals of Fluid Mechanics, John Wiley and Sons Inc., NewYork, 1990.
3. Schlichting H., Boundary layer theory, Mc Graw Hill Book Company, 1979
4. Shames, Mechanics of Fluids, Mc Graw Hill Book Company, 1962.
5. Streeter V.L., Wylie E.B. and Bedford K.W., Fluid Mechanics, WCB McGraw Hill, Boston, 1998

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B.Tech. Mechanical Engineering

Honors

20HDME109 Modelling of SI and CI Engines

L	T	P	C
3	0	0	3

Course description:

Combustion, also known as burning, is the basic chemical process of releasing energy from a fuel and air mixture. In an internal combustion engine (ICE), the ignition and combustion of the fuel occurs within the engine itself. The engine then partially converts the energy from the combustion to work. This course deals about various kinetics and combustion involved in SI and CI engines.

Course objectives:

- To develop the knowledge about combustion kinetics in SI and CI engines.
- To understand the combustion reaction kinetics in SI and CI engines.

UNIT I **INTRODUCTION** **9 hours**

Gaseous, liquid and solid fuels, Application of the first and second laws of thermodynamics to combustion, – Low temperature reactions – Cool Flames – as applied to detonation. High temperature reactions – species concentration and products formation.

UNIT II **CHEMICAL KINETICS OF COMBUSTION** **9 hours**

Elementary reactions, Pre-ignition kinetics, Ignition delay, Nitric Oxide Kinetics, Soot Kinetics, Calculations, – Reaction control effect on Engine performance and emissions.

UNIT III **MODELLING** **9 hours**

Calculation of equilibrium composition. Enthalpy and Energy, Coefficients for reactions and adiabatic flame temperature, Modelling of CO, HC NO reactions in SI and CI Engines – Soot Modelling

UNIT IV **S.I ENGINE COMBUSTION** **9 hours**

Combustion in S.I. Engines, Laminar flame theory, Flame structure, Turbulent premixed flames, Homogeneous Combustion reactions between Gasoline and air – Reaction rate Constants – species determination. Burning rate estimation.

UNIT V **C.I ENGINE COMBUSTION** **9 hours**

Combustion in CI Engine, Spray formation, Spray dynamics, Spray models, Introduction to diesel engine combustion, Premixed and diffusion combustion reactions – Lean flame Reactions – Lean flame out reactions - Species determination. Emissions and Combustion, Ignition Delay and Burning rate estimation.

Course outcomes:

The students after completing the course will be able to:

1. understand the concept of combustion kinetics
2. Modelling of the combustion process of different fuels
3. Modelling advanced combustion process
4. Understand and formulate the kinetics for CI engine combustion
5. Understand and formulate the kinetics for SI engine combustion

Textbooks:

1. J.F. Ferguson, Internal Combustion Engines, John Wiley and Sons, 2004.
2. I R.S. Benson & N.D. Whitehouse, Internal Combustion Engines, First edition, Pergamon Press, England 1979.

References:

1. Combustion Engineering, Gary L Bormann, WCB Mc Graw Hill, 1998.
2. John. B. Heywood, "Internal Combustion engine fundamentals" McGraw – Hill, 1988.
3. A.F. Williams, combustion in flames, Oxford Press, Second Edition, 1978.
4. S.P. Sharma, Fuels and Combustion, S.P. Chand and Co., Sixth Edition, 1982.

S. S. W. Benson. The Foundations of Chemical Kinetics. McGraw-Hill, 1960.
Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B.Tech. Mechanical Engineering				
Honors				
20HDME601 Simulation and Analysis using ANSYS				
SOC				
	L	**T**	**P**	**C**
	1	0	2	2
Pre-requisite: 20ME105, 20ME111, 20ME107, 20ME106				
Course Description:				
This course aims to lay out the fundamental concepts and results covering stress, thermal, and harmonic analysis of mechanical components using different modules of Ansys Software.				
Course objectives:				
1. Analysing the force and stress in mechanical components. 2. Analysing deflection in mechanical components. 3. Analysing thermal stress of mechanical components 4. Analysing heat transfer in mechanical components. 5. Analysing the vibration of mechanical components				
UNIT I	**Introduction**			**9 hours**
Study of Basics in ANSYS, Introduction of different modules of the Ansys: design modeler, workbench, APDL, Fluent, CFX. Different approaches of simulation: FDM, FEM, FVM. General processing and details study of Meshing and controlling of meshing				
UNIT II	**Simulation and analysis of a Fluid flow problem**			**9 hours**
Basic Navier-stokes equation for laminar and turbulent flow, Geometry, Material Properties, boundary Conditions, turbulence models, Solution Options, Results, and Postprocessing, Case Studies: Any two				
UNIT III	**Simulation and analysis of a Thermal problem**			**9 hours**
Basics Steady State Heat Transfer, Geometry, Material Properties, Thermal Boundary Conditions, Solution Options, Results, and Postprocessing, Case Studies: Any two				
UNIT IV	**Simulation and structural analysis**			**9 hours**
Basics of Static Structural Analysis, Geometry, Material Properties, Contact, Analysis Settings, Loads and Supports, Nodal Loads and Supports, Solving Models, Results, and Postprocessing, Case Studies: Any two				
UNIT V	**Simulation and Vibration analysis**			**9 hours**
Basics of Free Vibration, Geometry creations, Contact, Solution Setup, Modal Results, Vibration with Prestress, Case Studies: Any two				
Course outcomes:				
The students after completing the course will be able to:				

1. Find out the effect of force and impact of stress on the mechanical components.
2. Calculate the deflection occurring on the mechanical components.
3. Get a detailed understanding of the thermal stress creation and its mechanism of spreading in mechanical components.
4. Gain knowledge regarding the mechanism of heat transfer in mechanical components.
5. Find out the vibration effects on mechanical components.

Text books:

1. Matsson, J. E. (2022). *An introduction to ANSYS Fluent 2022*
2. Anderson, J. D., & Wendt, J. (1995). *Computational fluid dynamics* (Vol. 206, p. 332). New York: McGraw-Hill.
3. Newland, D. E., & Ungar, E. E. (1990). Mechanical vibration analysis and computation.
4. Jaluria, Yogesh. *Computational heat transfer*. Routledge, 2017.
5. Hibbeler, R. C., & Tan, K. H. (2006). *Structural analysis* (pp. 6-4). Upper Saddle River: Pearson Prentice Hall.

References:

1. Andronov, A. A., Vitt, A. A., & Khaikin, S. E. (1981). Theory of vibration. *Moscow Izdatel Nauka*.
2. Holman, J. P. (1986). *Heat transfer*. McGraw Hill.
3. Leet, K., Uang, C. M., & Gilbert, A. M. (2008). *Fundamentals of structural analysis*. New York, NY, USA:: McGraw-Hill Higher Education.

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

MITS - ME - R20

MINOR

(DIGITAL MANUFACTURING)

B.Tech. Mechanical Engineering

Minor

20MDME105 Smart Sensors and Industry 4.0

L	T	P	C
3	0	0	3

Course Description:

Introduction of application of hardware, communication protocol, IOT platform, machine learning etc. to implement IoT for smart manufacturing for the need of Industry 4.0

Course objectives:

- Impart knowledge of smart manufacturing for industry 4.0 for making student innovative.

UNIT I	**Introduction to Industry 4.0**	**9 hrs**

Industry 4.0 Concept, Globalization and emerging issues, The Fourth Revolution, LEAN manufacturing, Smart and connected business perspectives, Smart factories, case studies.

UNIT II	**Automation**	**9 hrs**

Programable Logic Controller (PLC) and its Programming software, Communication of different devices with PLC, Sensor, Smart Sensor, HMI design, Cyber Physical System – key components, ISA-95 architecture, CPS-5C architecture, Concept of Digit Twin

UNIT III	**Communication**	**9 hrs**

Protocols – MQTT, OPC UA, EtherNet/IP, Profinet, EtherCAT, etc; MQTT – History, MQTT broker, Message types, Quality of Service (QoS), Application; OPC UA – History, Specification, Client, Server, Programming with – Free and open-source software, Propriety software; Augmented Reality

UNIT IV	**IoT Platform**	**9 hrs**

Data Modelling, IoT platforms – Thing, basic functionalities, Abstract definition of Thing, Networks, etc; IoT Gateway, Machine interfaces – Cloud-based Mosquitto brokers, Programming with – Free and open-source software, Propriety software

UNIT V	**Machine Learning Foundation**	**9 hrs**

Learning algorithms – Supervised, Unsupervised, Self-learning, Feature learning, etc. Models – Artificial Neural Networks, Decision trees, Regression analysis, Genetic algorithms, etc.; Programming with – Free and open-source software, Propriety software

Course outcomes (co):

At the end of the course the students would be able to:

1. Introduce concept of Industry 4.0 for Smart Manufacturing.
2. Understand use various hardware used in Smart Manufacturing.
3. Understand need of various communication protocols. hardware and software, IoT Layers and their relative importance.
4. Understand could-computing IoT platform for Smart Manufacturing.
5. Understand machine learning to make smart factories

Text books:

1. Christoph Jan Bartodziej, "The Concept Industry 4.0 – An Empirical Analysis of Technologies and Application in Production Logistics", Spinger Gabler, 2015
2. Alasdair Gilchrist, "Industry 4.0 – The Industrial Internet of Thigs", Springer Link, 2016

References:

1.Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications.
2. Michahelles, "Architecting the Internet of Things", ISBN 978-3- 642-19156-5 e-ISBN 978-3-642-19157-2, Springer.
3. Hakima Chaouchi, "The Internet of Things Connecting Objects to the Web" ISBN : 978-1-84821-140-7, Willy Publications.

4. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key Applications and Protocols", ISBN: 978-1-119-99435-0, 2nd Edition, Wiley Publications
5. W. Bolton, "Programmable Logic Controllers", Fourth Edition, Elsevier, 2006
6. P. Juahs, K. Molnar, "Key Components of the Architecture of Cyber-physical manufacturing systems", International Scientific Journal "Industry 4.0", 2017, issue 5, 205-207
7. Jen-Ruey Jiang, "An improved cyber-physical systems architecture for Industry 4.0 smart factories", Advances in Mechanical Engineering, 2018, Vol. 10(6) 1-15. Power Plant Engineering, As per AICTE: Theory and Practice by Dipak Kumar Mandal, Somnath Chakrabarti, et al. | 1 January 2019

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B.Tech. Mechanical Engineering

Minor

20MDME106 Lean Manufacturing

L	T	P	C
3	0	0	3

Course Description:

Lean manufacturing is a methodology that focuses on minimizing waste within manufacturing systems while simultaneously maximizing productivity. Waste is seen as anything that customers do not believe adds value and are not willing to pay for. Some of the benefits of lean manufacturing can include reduced lead times, reduced operating costs and improved product quality. Lean manufacturing, also known as lean production, or lean, is a practice that organizations from numerous fields can enable.

Course objectives:

1 To introduce the basics of 6 SIGMA
2 To learning about the lean manufacturing tools.
3 To study about the deeper understanding methodologies of Lean manufacturing.
4 To study the lean concepts and its elements.
5 To learn implementation and challenges of lean manufacturing.

UNIT I	**BASICS OF 6 SIGMA**	**9 hrs**

Introduction to 6 Sigma, basic tools of six sigma like problem solving approach, standard deviation, normal distribution, various sigma levels with some examples, value for the enterprise, Variation, and sources of variation, Mean and moving the mean, Various quality costs, cost of poor quality.

UNIT II	**INTRODUCTION TO LEAN MANUFACTURING TOOLS**	**9 hrs**

Process Capability Indices, Cause and Effect diagram, Control Charts, Introduction to FMEA, APQP, PPAP. 3 foundational 6 Sigma methodologies: DMAIC, DMEDI, and Process Management DMEDI for process creation, DMAIC for process improvement and PDCA for sustaining improvements.

UNIT III	**DEEPER UNDERSTADING METHODOLOGIES**	**9 hrs**

What is a process, Why Process management, Keys to process management, Difference between process management and 6 Sigma, Introduction to Deming cycle, PDCA, DMAIC and continuous improvement, DMEDI for creation process, DMAIC Vs DMEDI with examples, Introduction to Toyota Production System, Six Sigma and Production System integration.

UNIT IV	**LEAN ELEMENTS**	**9 hrs**

Introduction to Lean Concepts like In-Built Quality, Concept of Right Part at the Right Time, Lead Time reduction, Optimum utilization of Capital, Optimum utilization of People. Understanding the Zero-defect concept and Metrics, Focus on Human Resources, Quality, Delivery, Cost. Building Zero defect capabilities, Cultural and Organizational aspects.

UNIT V	**IMPLEMENTATION AND CHALLENGES**	**9 hrs**

Implementing Checks and Balances in the process, Robust Information Systems, Dashboard, follow up and robust corrective and preventive mechanism. Concept of Audits, and continuous improvement from gap analysis, risk assessments etc.

Course outcomes (co):

At the end of the course the students would be able to
1. Discuss the basics of 6 SIGMA
2. Elaborate the lean manufacturing tools.
3. Illustrate about the deeper understanding methodologies of Lean manufacturing.
4. Discuss lean concepts and its elements.
5. Describe the implementation and challenges of lean manufacturing.

Textbooks:
1. Quality Planning and Analysis- JM Juran& FM Gryna. Tata Mc Graw Hill 2. Lean Manufacturing: Principles to Practice by Akhilesh N. Singh, Bibliophile SouthAsia 3. The Toyota Way: 14 Management Principles 4. Gemba Kaizen: A Commonsense Approach to a Continuous Improvement Strategy,Masaki Imai
References:
1. Quality Council of India https://qcin.org/ & its library. https://qcin.org/nbqp/knowledge_bank/ 2. International Society of Six Sigma Professionals: https://isssp.org/about-us/ 3. NPTEL / SWAYAM: https://nptel.ac.in/courses/110105123 : Six Sigma, Prof. Jitesh J Thakkar, IIT Kharagpur, Certification course. (Self- Learning). 4. Older / Previous editions of AIAG manuals on APQP, FMEA and PPAP. These are great sources of information on Quality Planning and has basics of Project Management and required skills. 5. Quality Management for Organizations Using Lean Six Sigma Techniques- Erick C Jones
Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

MITS - ME - R20

MINOR

(ENERGY ENGINEERING)

B.Tech. Mechanical Engineering

Minor

20MDME111 Design of Gas Turbine Engines

L	T	P	C
2	1	0	3

Course description:

A gas turbine engine is a device that is designed to convert the thermal energy of a fuel into some form of useful power, such as mechanical (or shaft) power or a highspeed thrust of a jet. This subject deals with design fundamentals of such sophisticated gas turbine engines.

Course objectives:

1.To elucidate the fundamental of gas turbine
2. To explain about fluid dynamics and fundamentals of rotating machines
3. To Give proper idea about jet propulsion and cycle arrangements with different types of machines.
4. To explain the Gas Turbine with various operating cycles
5. To Analyze the performance of Gas Turbine.

UNIT I | **FUNDERMENTALS OF GAS TURBINE** | **9 hours**

Gas Turbine – theory & fundamentals of Gas Turbine, Principle, Classification, Energy equations, Fluid dynamics, Streamtube Area-Velocity Relation, Normal Shock Waves and Equations, Oblique Shock and Expansion Waves, Flow with friction and Heat transfer, Flow in Constant-Area Duct with Friction

UNIT II | **FUNDERMENTALS OF ROTATING MACHINE** | **9 hours**

General Fluid Dynamics Analysis, Classification of compressor and turbines, Efficiency of Rotating Machines, Elementary Airfoil Theory, Cycle Arrangements- Open cycle & Closed Cycle, Working Medium and its Properties, Ideal Cycle and analysis

UNIT III | **JET PROPULSION CYCLES AND THEIR ANALYSIS** | **9 hours**

Reciprocating or Propeller Engines, Gas Turbine Engines- Types, The Ramjet Engine, The Pulse Jet Engine, Turboprop Engine, Turbojet engine, Thrust-Thrust Equation, Parameters effecting flight performance

UNIT IV | **CENTRIFUGAL COMPRESSOR** | **9 hours**

Parts of Centrifugal Compressor- Principle of Operation, Blade Shapes and Velocity of Triangles, Analysis of Flow Through Compressor, Diffuser, Volute Casing, Compressor Characteristics, Surging and Chocking, Axial Flow Compressor- Working Principle- Stage Velocity Triangles, A Single Impulse Stage, A Single Reaction Stage, Multistage machines, Velocity Triangles, Losses and Efficiencies

UNIT V | **TRANSONIC AND SUPERSONIC COMPRESSOR AND TURBINES** | **9 hours**

The Supersonic Compressor, Supersonic Axial Flow Compressor, Supersonic Radial Compressor, Supersonic Axial Flow Turbines Stages, Inlets, Diffuser, Supersonic and Subsonic Inlets, Exhaust Nozzles, Blades- Materials-Manufacturing Techniques, Blade Fixing-Cooling, Problems on High Temperature Operations

Course outcomes:

The students after completing the course will be able to:

1. Apply energy equations, various laws used in the design of turbomachines.
2. Able to explain centrifugal and axial flow compressor with Velocity Triangles, Losses and Efficiencies
3. Explain basic phenomenon of jet propulsion cycles and parameters effecting on its performance.
4. Understand working principles of supersonic compressor and turbine stages.
5. Able to estimate the performance of Gas turbine and know different parts of it.

Text books:
1.V. Ganesan, Gas Turbine, Tata McGraw Hill Education Pvt. Lmt., 2012, 8th edition. 2.H. Cohen, Gas Turbine Theory, 4th Edition, Longman, 1998
Data Book:
Not Required
References:
1. B. Lakshminarayana, Fluid Dynamics & Heat Transfer of Turbomachinery, John Wiley & Sons, 1996. 2. Jack D. Mattingly, Elements of Gas Turbine Propulsion, McGraw-Hill, Inc., 1996.
Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

B.Tech. Mechanical Engineering

Minor

20MDME112 Fluid Power System

L	T	P	C
2	1	0	3

Course description:

The goal of this course is to give ideas about the fundamental properties of fluid and fluid power systems. Topics to be covered include Fluids for hydraulic systems, governing laws. Distribution of fluid power, Design, and analysis of typical hydraulic circuits. Know accessories used in fluid power system, Filtration systems and maintenance of system.

Course objectives:

- To recognize the standard symbols and to understand the functions of basic fluid power generation and actuation elements.
- To realize the functions of fluid regulation and control elements and its typical uses in pumps and actuators.
- To familiar and exercise the design procedure of various types of hydraulic fluid power components and its circuits design.
- To learn about the fundamentals of Pneumatic power systems and Actuators and it's working principles involved in each component in the system.
- To familiar and exercise pneumatic control systems design and associated applications.

UNIT I	Introduction to fluid power systems	9 hours

Fluid power system: components, advantages and applications. Transmission of power at static and dynamic states. Pascal's law and its applications. Fluids for hydraulic system: types, properties, and selection. Seals, sealing materials, compatibility of seal with fluids. Types of pipes, hoses, and quick acting couplings. Pressure drop in pipes. Fluid conditioning through filters, strainers; sources of contamination and contamination control; heat exchangers.

UNIT II	Hydraulic Pumps and Actuators	9 hours

Classification of pumps, positive displacement pumps, construction and working of Gear pumps, Vane pumps, Piston pumps, fixed and variable displacement pumps, Pump performance characteristics, Hydraulic Actuators: Classification, Hydraulic cylinders, single and double acting cylinder, mounting arrangements, cushioning, special types of cylinders, problems on cylinders. Construction and working of rotary actuators such as gear, vane, piston motors, and Hydraulic Motor. Theoretical torque, power, flow rate, and hydraulic motor performance; numerical problems.

UNIT III	Hydraulic circuit components and its design	9 hours

Classification of control valves, Directional Control Valves-symbolic representation, constructional features of poppet, sliding spool, rotary type valves solenoid and pilot operated DCV, shuttle valve, and check valves. Control of single and Double -acting hydraulic cylinder, regenerative circuit, pump unloading circuit, double pump hydraulic system, counter balance valve application, hydraulic cylinder sequencing circuits, cylinder synchronizing circuit using different methods, hydraulic circuit for force multiplication; speed control of hydraulic cylinder- metering in, metering out and bleed off circuits.

UNIT IV	Pneumatic power systems and Actuators	9 hours
Pneumatic power system, advantages, limitations, applications, Structure of pneumatic control System, fluid conditioners-dryers and FRL unit. Pneumatic Actuators. Linear cylinder – types of cylinders, working, end position cushioning, seals, mounting arrangements, and applications. Rotary cylinders- types, construction and application, symbols. Pneumatic Control Valves. DCV such as poppet, spool, suspended seat type slide valve, pressure control valves, flow control valves, types and construction.		
UNIT V	**Pneumatic control circuits**	**9 hours**
Direct and indirect actuation pneumatic cylinders, speed control of cylinders - supply air throttling and exhaust air throttling. Use of OR and AND logic gates in pneumatic applications. Case studies involving the use of logic gates. Coordinated and sequential motion control, motion and control diagrams. Signal elimination methods, Cascading method principle, Practical application examples (up to two cylinders) using cascading method (using reversing valves).		

Course outcomes:

The students after completing the course will be able to:

1. Identify and analyse the functional requirements of a fluid power transmission system for a given application.

2. Visualize how a hydraulic/pneumatic circuit will work to accomplish the function.

3. Design an appropriate hydraulic or pneumatic circuit or combination circuit like electro-hydraulics, electro-pneumatics for a given application.

4. Select and size the different components of the circuit.

5. Develop a comprehensive circuit diagram by integrating the components selected for the given application.

Text books:

1. Anthony Esposito, "Fluid Power with applications", Pearson edition,2000 .

2. Majumdar S.R., "Oil Hydraulics",TalaMcGRawHIIL, 2002 .

3. Majumdar S.R., "Pneumatic systems - Principles and Maintenance",Tata McGraw-Hill, New Delhi, 2005.

References:

1. John Pippenger, Tyler Hicks, "Industrial Hydraulics", McGraw Hill International Edition, 1980.

2. Andrew Par, Hydraulics and pneumatics, Jaico Publishing House, 2005.

3. FESTO, Fundamentals of Pneumatics,Voll,IIandIII.

4. Herbert E. Merritt, "Hydraulic Control Systems", John Wiley and Sons, Inc.

5. Thomson, Introduction to Fluid power, PrentcieHail, 2004

6. John Watton, "Fundamentals of fluid power control", Cambridge University press, 2012

Mode of Evaluation: Assignments, Internal Mid Tests and External End Examinations

Availability to attend Board of Studies (BoS) Meeting to be scheduled on 17 June 2023 (Online) – Dept. of Mechanical Engineering, Madanapalle Institute of Technology and Science – Reg.

M E Head of the Department <mehod@mits.ac.in>

To:durga.mech@jntua.ac.in <durga.mech@jntua.ac.in>;Anil Kumar <anil@iittp.ac.in>;Venkatesham B <venkatesham@mae.iith.ac.in>;kashinathlpm@gmail.com <kashinathlpm@gmail.com>;Anand Swaroop Donepudi <ananddonepudi@gmail.com>

Cc:Dr Anantha Raman L <drananthramanl@mits.ac.in>;Vice Principal Academics <viceprincipalacademics@mits.ac.in>;Principal MITS <principal@mits.ac.in>;Principal Office <principaloffice@mits.ac.in>;M E Office <meoffice@mits.ac.in>

Respected Sir,

Greetings from Dr. M. Lakshmana Rao, Professor & Head, Dept. of Mechanical Engineering, Madanapalle Institute of Technology and Science, Madanapalle, Andhra Pradesh.

I am writing this email to know your availability to attend the **Board of Studies (BoS)** Meeting planned to be conducted on **17 June 2023 (Saturday), from 2.00 PM to 5.00 PM**. The meeting will be conducted online mode via Microsoft Teams.

Please let me know your availability to attend the meeting so that I can schedule it accordingly.

A formal invitation email with a meeting link will be sent once the date and time are confirmed by all the members of the BoS.

For further discussion, feel free to contact me anytime via phone / email.

With Regards

Dr. M. Lakshmana Rao
Professor & Head
Department of Mechanical Engineering
MITS, Angallu, Madanapalle-517325
Ph. 9160020782, 9849140465
Email: mehod@mits.ac.in

Re: Availability to attend Board of Studies (BoS) Meeting to be scheduled on 17 June 2023 (Online) – Dept. of Mechanical Engineering, Madanapalle Institute of Technology and Science – Reg.

Anand Swaroop Donepudi <ananddonepudi@gmail.com>

To: M E Head of the Department <mehod@mits.ac.in>

Cc: durga.mech@jntua.ac.in <durga.mech@jntua.ac.in>;Anil Kumar <anil@iittp.ac.in>;Venkatesham B <venkatesham@mae.iith.ac.in>;kashinathlpm@gmail.com <kashinathlpm@gmail.com>;Dr Anantha Raman L <drananthara manl@mits.ac.in>;Vice Principal Academics <viceprincipalacademics@mits.ac.in>;Principal MITS <principal@mits.ac.in>;Principal Office <principaloffice@mits.ac.in>;M E Office <meoffice@mits.ac.in>

Hi sir

I will attend the meeting.

Anand Donepudi

On Thu, 8 Jun, 2023, 1:51 pm M E Head of the Department, <mehod@mits.ac.in> wrote:

Respected Sir,

Greetings from Dr. M. Lakshmana Rao, Professor & Head, Dept. of Mechanical Engineering, Madanapalle Institute of Technology and Science, Madanapalle, Andhra Pradesh.

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MITS, Angallu, Madanapalle-517325
Ph. 9160020782, 9849140465
Email: mehod@mits.ac.in

Re: Availability to attend Board of Studies (BoS) Meeting to be scheduled on 17 June 2023 (Online) – Dept. of Mechanical Engineering, Madanapalle Institute of Technology and Science – Reg

Dr. B. Durga Prasad <durga.mech@jntua.ac.in>

To: M E Head of the Department <mehod@mits.ac.in>

Cc: Anil Kumar <anil@iittp.ac.in>, Venkatesham B <venkatesham@mae.iith.ac.in>, kashinathlpm@gmail.com <kashinathlpm@gmail.com>, Anand Swaroop Donepudi <ananddonepudi@gmail.com>, Dr Anantha Raman L <drananthara manl@mits.ac.in>, Vice Principal Academics <viceprincipalacademics@mits.ac.in>, Principal MITS <principal@mits.ac.in>, Principal Office <principaloffice@mits.ac.in>, M E Office <meoffice@mits.ac.in>

I will attend the meeting.

On Thu, 8 Jun 2023, 13:51 M E Head of the Department, <mehod@mits.ac.in> wrote:

Respected Sir,

Greetings from Dr. M. Lakshmana Rao, Professor & Head, Dept. of Mechanical Engineering, Madanapalle Institute of Technology and Science, Madanapalle, Andhra Pradesh.

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With Regards

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Department of Mechanical Engineering
MITS, Angallu, Madanapalle-517325
Ph. 9160020782, 9849140465
Email: mehod@mits.ac.in

Re. Availability to attend Board of Studies (BoS) Meeting to be scheduled on 17 June 2023 (Online) – Dept. of Mechanical Engineering, Madanapalle Institute of Technology and Science – Reg.

Kashinath LPM <kashinathlpm@gmail.com>

To:M E Head of the Department <mehod@mits.ac.in>

Cc:durga.mech@jntua.ac.in <durga.mech@jntua.ac.in>;Anil Kumar <anil@iittp.ac.in>;Venkatesham B <venkatesham@mae.iith.ac.in>;Anand Swaroop Donepudi <ananddonepudi@gmail.com>;Dr Anantha Raman L <drananthara manl@mits.ac.in>;Vice Principal Academics <viceprincipalacademics@mits.ac.in>;Principal MITS <principal@mits.ac.in>;Principal Office <principaloffice@mits.ac.in>;M E Office <meoffice@mits.ac.in>

Dear Sir,
Thank you for the mail, I am attending the scheduled BoS meeting.

Regards
Kashinath

From Kashinath mobile

On 08-Jun-2023, at 1:51 PM, M E Head of the Department <mehod@mits.ac.in> wrote:

Respected Sir,

Greetings from Dr. M. Lakshmana Rao, Professor & Head, Dept. of Mechanical Engineering, Madanapalle Institute of Technology and Science, Madanapalle, Andhra Pradesh.

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With Regards

Dr. M. Lakshmana Rao
Professor & Head
Department of Mechanical Engineering
MITS, Angallu, Madanapalle-517325
Ph. 9160020782, 9849140465

Re: Availability to attend Board of Studies (BoS) Meeting to be scheduled on 17 June 2023 (Online) – Dept. of Mechanical Engineering, Madanapalle Institute of Technology and Science – Reg.

Venkatesham B <venkatesham@mae.iith.ac.in>

To:M E Head of the Department <mehod@mits.ac.in>

Dear Professor,
I am available on 17th June afternoon.

Thanking you
Wr
Venkatesham

On Thu, 8 Jun, 2023, 1:51 pm M E Head of the Department, <mehod@mits.ac.in> wrote:

Respected Sir,

Greetings from Dr. M. Lakshmana Rao, Professor & Head, Dept. of Mechanical Engineering, Madanapalle Institute of Technology and Science, Madanapalle, Andhra Pradesh.

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For further discussion, feel free to contact me anytime via phone / email.

With Regards

Dr. M. Lakshmana Rao
Professor & Head
Department of Mechanical Engineering
MITS, Angallu, Madanapalle-517325
Ph. 9160020782, 9849140465
Email: mehod@mits.ac.in

Disclaimer:- This footer text is to convey that this email is sent by one of the users of IITH. So, do not mark it as SPAM

Re: Availability to attend Board of Studies (BoS) Meeting to be scheduled on 17 June 2023 (Online) – Dept. of Mechanical Engineering, Madanapalle Institute of Technology and Science – Reg.

Anil Kumar <anil@iittp.ac.in>

To:M E Head of the Department <mehod@mits.ac.in>

Dear Sir

Thanks for your mail. I will attend the meeting.

Thanks and regards

Anil

On Thu, 8 Jun 2023, 13:51 M E Head of the Department, <mehod@mits.ac.in> wrote:

Respected Sir,

Greetings from Dr. M. Lakshmana Rao, Professor & Head, Dept. of Mechanical Engineering, Madanapalle Institute of Technology and Science, Madanapalle, Andhra Pradesh.

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For further discussion, feel free to contact me anytime via phone / email.

With Regards

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Ph. 9160020782, 9849140465
Email: mehod@mits.ac.in

Minutes of Board of Studies (BoS) Meeting held on 17-06-2023 - Reg

M E Head of the Department <mehod@mits.ac.in>

To: durga.mech@jntua.ac.in <durga.mech@jntua.ac.in>; Anil Kumar <anil@iittp.ac.in>; Venkatesham B <venkatesham@mae.iith.ac.in>; kashinathlpm@gmail.com <kashinathlpm@gmail.com>; Anand Swaroop Donepudi <ananddonepudi@gmail.com>

Cc: Principal MITS <principal@mits.ac.in>; Vice Principal Academics <viceprincipalacademics@mits.ac.in>; Mechanical Department <ME@mits.ac.in>

ME R20-4-1 SYLLABUS 22-7-2023 06 BOS Meeting Minutes v2.pdf

Respected Sir,

Greetings from Dr. M. Lakshmana Rao, Professor & Head, Dept. of Mechanical Engineering, Madanapalle Institute of Technology and Science, Madanapalle, Andhra Pradesh.

I have attached the minutes of the Board of Studies (BoS) meeting held on 17-06-2023 with action taken report. I request you to go through the minutes and let me know if any further changes / improvements are needed.

All suggestions given by the members of BoS were implemented in the curriculum & syllabus.

Kindly approve the minutes by reply email for documentation purpose.

The following documents are attached for your reference:
1. BoS Minutes
2. R20 - Course Structure.
3. R20 - Syllabi for all 4-1 & 4-2 semester subjects.

With Regards

Dr. M. Lakshmana Rao
Professor & Head
Department of Mechanical Engineering
MITS, Angallu, Madanapalle-517325
Ph. 9160020782, 9849140465
Email: mehod@mits.ac.in

Re: Minutes of Board of Studies (BoS) Meeting held on 17-06-2023 - Reg.

Dr. B. Durga Prasad <durga.mech@jntua.ac.in>

To:M E Head of the Department <mehod@mits.ac.in>
Cc:Kashinath LPM <kashinathlpm@gmail.com>;Dr Anantha Raman L <dranantharamanl@mits.ac.in>

Approved.

On Tue, 4 Jul 2023, 10:32 M E Head of the Department, <mehod@mits.ac.in> wrote:

Respected Sir,

Greetings from Dr. M. Lakshmana Rao, Professor & Head, Dept. of Mechanical Engineering, Madanapalle Institute of Technology and Science, Madanapalle, Andhra Pradesh.

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With Regards

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Email: mehod@mits.ac.in

Re: Minutes of Board of Studies (BoS) Meeting held on 17-06-2023 - Reg.

Anil Kumar <anil@iittp.ac.in>

To M E Head of the Department <mehod@mits.ac.in>
Cc durga.mech@jntua.ac.in <durga.mech@jntua.ac.in>;Venkatesham B <venkatesham@mae.iith.ac.in>;Kashinath LPM <kashinathlpm@gmail.com>;Anand Swaroop Donepudi <ananddonepudi@gmail.com>;Principal MITS <principal@mits.ac.in>;Vice Principal Academics <viceprincipalacademics@mits.ac.in>;**Mechanical Department <ME@mits.ac.in>**

Dear Sir

I approve the minutes.

Thanks and regards

Anil

On Fri, 30 Jun 2023, 12:35 M E Head of the Department, <mehod@mits.ac.in> wrote:

Respected Sir,

Greetings from Dr. M. Lakshmana Rao, Professor & Head, Dept. of Mechanical Engineering, Madanapalle Institute of Technology and Science, Madanapalle, Andhra Pradesh.

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With Regards

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Re: Minutes of Board of Studies (BoS) Meeting held on 17-06-2023 - Reg

Venkatesham B <venkatesham@mae.iith.ac.in>

To:Anand Swaroop Donepudi <ananddonepudi@gmail.com>
Cc:M E Head of the Department <mehod@mits.ac.in>;durga.mech@jntua.ac.in <durga.mech@jntua.ac.in>;Anil Kumar <anil@iittp.ac.in>;kashinathlpm@gmail.com <kashinathlpm@gmail.com>;Principal MITS <principal@mits.ac.in>;Vice Principal Academics <viceprincipalacademics@mits.ac.in>;**Mechanical Department <ME@mits.ac.in>**

Approved

On Fri, Jun 30, 2023 at 12:46 PM Anand Swaroop Donepudi <ananddonepudi@gmail.com> wrote:

Hi Sir,

Appreciate the efforts from your team and Please consider this as my approval on MOM.

Anand Donepudi

On Fri, 30 Jun 2023 at 12:35, M E Head of the Department <mehod@mits.ac.in> wrote:

Respected Sir,

Greetings from Dr. M. Lakshmana Rao, Professor & Head, Dept. of Mechanical Engineering, Madanapalle Institute of Technology and Science, Madanapalle, Andhra Pradesh.

I have attached the minutes of the Board of Studies (BoS) meeting held on 17-06-2023 with action taken report. I request you to go through the minutes and let me know if any further changes / improvements are needed.

All suggestions given by the members of BoS were implemented in the curriculum & syllabus.

Kindly approve the minutes by reply email for documentation purpose.

The following documents are attached for your reference:
1. BoS Minutes
2. R20 - Course Structure.
3. R20 - Syllabi for all 4-1 & 4-2 semester subjects.

With Regards

Dr. M. Lakshmana Rao
Professor & Head
Department of Mechanical Engineering
MITS, Angallu, Madanapalle-517325
Ph. 9160020782, 9849140465
Email: mehod@mits.ac.in

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Regards...
AnandSwaroop

Re: Minutes of Board of Studies (BoS) Meeting held on 17-06-2023 - Reg

Anand Swaroop Donepudi <ananddonepudi@gmail.com>

To M E Head of the Department <mehod@mits.ac.in>
Cc durga.mech@jntua.ac.in <durga.mech@jntua.ac.in>,Anil Kumar <anil@iittp.ac.in>,Venkatesham B <venkatesham@mae.iith.ac.in>,kashinathlpm@gmail.com <kashinathlpm@gmail.com>,Principal MITS <principal@mits.ac.in>,Vice Principal Academics <viceprincipalacademics@mits.ac.in>,**Mechanical Department <ME@mits.ac.in>**

Hi Sir,

Appreciate the efforts from your team and Please consider this as my approval on MOM.

Anand Donepudi

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Regards...
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