DEPARTMENT OF MECHANICAL ENGINEERING

Date: 22-03-2024

CIRCULAR

It is hereby informed Mechanical Engineering Faculty Members that you are cordially invited to participate in a **One-Week** Faculty Development Program (**FDP**) on **"Modelling and Design for Manufacturing using Fusion 360 by AUTODESK"** will be conducted from **March 25-30, 2024 (9:00 AM - 4:00 PM)**. This program is organized in association with Medini Technologies, as part of the Memorandum of Understanding (MoU) signed with Visvesvaraya Technological University, Belagavi.

Venue:

Mechanical Dept -CAD lab -2

ORGANISERS **HOD**

Dr. Shivaramakrishna A

Dr. Pavan Kumar B K

Assistant Professors, Dept. of ME, BITM, Ballari

1. Details of the Activity Conducted

Type of Activity	Name of Activity	Mode of Conduct	Level	Date
IIC Driven	**Modelling and Design for Manufacturing using FUSION 360 by AUTODESK**	**Offline**	**Level 1**	**25th – 30th March 2024**

2. Activity Banner

ABOUT FDP:

The FDP aims to empower faculty members of VTU-affiliated institutes with cutting-edge skills in Fusion 360. Benefit from hands-on training, expert insights, and collaboration with Autodesk as academic partners, ensuring faculty readiness for delivering high-quality education in advanced design and manufacturing technologies.

CHIEF PATRONS

Dr. Yashvanth Bhupal
Chairman, BITM

Mr. Y J Prithviraj Bhupal
Director, BITM

Mr. Pradeep Kallur
Managing Director, Medini Technologies

PATRONS

Dr. Yadavalli Basavaraj
Principal, BITM

CONVENER

Dr. V Venkata Ramana
Professor & Head, Dept. of ME, BITM

Dr. Raghavendra Joshi
Professor, CoE, BITM

ORGANISERS

Dr. Shivaramakrishna A, Assistant Professor
Dept. of ME, BITM, Mob: +91 9916252513

Dr. Pavan Kumar B K Assistant Professor
Dept. of ME, BITM, Mob: +91 9845863576

CONVENER ORGANISING COMMITTEE

Dr. B Ganesh, Asso. Professor
Dr. Lakshmi Kumari, Asso. Professor
Dr. H.M. Anil Kumar, Asso. Professor
Dr. Banakar Nagaraja, Asso. Professor
Dr. Manjunatha TH, Asso. Professor
Dr. Santhosh Janamatti, Asst. Professor
Dr. K Shekar, Asst. Professor
Mr. V Srinivasulu, Asst. Professor
Mr. Vishnu Prasad B, Asst. Professor
Mr. Jayaprakesh B , Asst. Professor
Mr. K Raghavendra, Asst. Professor
Mr. Mayur Pawar D, Asst. Professor
Mr. B P Vijay Kumar, Asst. Professor
Mr. Venkatesh K C, Asst. Professor
Mr. B Maharaja Gouda, Asst. Professor
Mr. Shiva Kumar S Y, Asst. Professor
Mr. Gavisiddappa P, Asst. Professor
Mr. Raghavendra Kamool, Asst. Professor
Mr. Taranath A, Asst. Professor
Mr. Mohammed Fayaz K, Asst. Professor
Mr. Manjunath E, Asst. Professor
Mr. K. Rajashekar, Asst. Professor
Mr. Kalyan Babu, Asst. Professor
Mr. Irayya Shikkerimath, Asst. Professor

3. Resource Person Profile

Mr. Maruthi G V is a Design Engineer at Medini Technologies, Bangalore. He completed his B.E. in Mechanical Engineering from VTU, and his M.E in UBDT, Davangere. Later joined as an Assistant Professor, at STJ Institute of Technology Full-time from Aug 2014 - Aug 2021.

He has immense knowledge and skills in Fusion 360 software from September 2021 to the present as a design engineer and trainer. And also carried out many real-time projects related to product design manufacturing, mechanisms, and simulations.

4. Objectives and Course contents

OBJECTIVES

The main objective of the FDP is to provide an interdisciplinary forum for faculties and industry persons, engaged in the full spectrum of R&D and applications and to discuss the current state of Modelling and Design for Manufacturing using Fusion 360 software with a focus on real-life applications.

COURSE CONTENTS

1. Introduction to Fusion360, Licence activation, Different workspaces, Introduction to Sketching Environment.
2. Create tools, modify tools, Constraints, Inspect tab, Insert tab, Select tab etc., and sketch examples.
3. Introduction to 3D modelling, create tab, modify tab, Solid modelling examples and introduction Rendering.
4. Introduction to Free forms, assembly, motion drafting etc.
5. Introduction to analysis workbench, comparing analytical and experimental results of different problems.
6. Introduction to manufacturing workspace, Different types of Milling and Turning operations.

5. Number of Participants Attended

No. of Participants Registered	**52**
No. of Participants Attended	**39**
No. of Colleges Participated	**5**

Attendance List of the Event:

Sl.No	NAME OF THE FACULTY		Email_ID	Phone_Number
	First Name	Last Name		
1	Dr. V.Venkata	Ramana	venkataramana@bitm.edu.in	8904399880
2	Dr. Shivaramakrishna	A	shivaramakrishna@bitm.edu.in	9916252513
3	Dr. Pavan Kumar	Bk	pavankumar@bitm.edu.in	9845863576
4	Dr.Santhosh	Janamati	santhoshvj@bitm.edu.in	9538358076
5	Vishnu Prasad	B	vishnuprasad@bitm.edu.in	9845804037
6	Mayur D	Pawar	mayur.dp@bitm.edu.in	9972583160
7	Vijaykumar	Bp	vijaykumarbp@bitm.edu.in	8494849410
8	Gavisiddappa	P	gavisiddesha@bitm.edu.in	9242213991
9	Rajashekar	K	rajashekark@bitm.edu.in	9036535875
10	Venkatesh	Kc	venkatesh.kc@bitm.edu.in	8880454511
11	Maharaja	Gowda	maharajagowda@bitm.edu.in	6363680595
12	K	Raghavendra	raghavendra@bitm.edu.in	9845358464
13	Dr. Kotresh	Sardar	sardar@rymec.in	9448341488
14	santosh	kumar	santoshkumar.ip@nie.ac.in	9986311533
15	Dr. Keerthikumar	N	keerthikumarn@bmsit.in	9743634934
16	Hafeezgayasudin	K	hafeezbellary@gmail.com	9481853888
17	Dr. Vaddin	Chetan	vaddin@rymec.in	7795518864
18	Dr.Balaraj	V	balaraj.v@rymec.in	8749075910
19	Dr. Mahesh	G	mahesh.g@rymec.in	8951567477
20	K	Mahesh	mahesh@bitm.edu.in	8073715982
21	Giri	Prasad B	giriprasad@bitm.edu.in	9036886788
22	Sridhar	M	sridhar.m@bitm.edu.in	9916415367
23	Vinodkumar	G	vinodkumar.g@bitm.edu.in	9972784992
24	Manjunath	E	manjunatha.e@bitm.edu.in	8217865280
25	Dr. Ganesh	B	ganesh@bitm.edu.in	9986504499
26	Dr. T. Lakshmi	Kumari	lakshmikumari@bitm.edu.in	8123689471
27	Dr. H M Anil	Kumar	anilkumar@bitm.edu.in	7483043444
28	Dr. Banakar	Nagaraj	banakaranagaraj@bitm.edu.in	9845414070
29	Dr. Manjunatha	Th	manjunatha.th@bitm.edu.in	9980096931
30	Dr. Shekar	K	shekar@bitm.edu.in	9986916091
31	B. Jaya	Prakash	jayaprakash@bitm.edu.in	9844739393
32	V	Srinivasulu	srinivasulu@bitm.edu.in	9036998616
33	Mohammed	Fayaz	mohammedfayaz@bitm.edu.in	8147282449
34	Shivakumar	Sy	shivakumarsy@bitm.edu.in	9916125043
35	Raghavendra	Shetty	raghavendrasetty@bitm.edu.in	9686413051
36	Raghavendra	Karnool	raghavendra.k@bitm.edu.in	7760960264
37	Taranath	A	a.taranath@bitm.edu.in	8095281437
38	Kalyan	Babu	kalyanbabu@bitm.edu.in	8197715208
39	Irayya	Shikkerimath	irayya.dshikkerimath@bitm.edu.in	8073216114

6. E-Certificate Issued

CERTIFICATE OF COMPLETION

CONGRATULATIONS!

You have successfully completed an Autodesk® Authorized Academic Partner® course specifically designed to meet your training requirements. Authorized Academic Partner instructors deliver quality-learning experiences with relevant courses, comprehensive content and engaging courseware. Autodesk's vision is to help people to imagine, design and create a better world.

Certificate No. AP701634097801205399005

SHIVARAMAKRISHNA A		
NAME		
6 DAYS FDP ON MACHINE DRAWING USING FUSION 360		**FUSION 360 NEW**
COURSE TITLE		**PRODUCT**
MARUTHI G V	**30-MARCH-2024**	**33-40 HOURS**
INSTRUCTOR	**COURSE DATE**	**COURSE DURATION**

M/S MEDINI
AUTODESK AUTHORIZED ACADEMIC PARTNER

Pradeep Kallur
Founder | Managing Director
Medini

Medini Technologies

AUTODESK Authorized Academic Partner

7. Feedback Analysis

BITM	BALLARI INSTITUTE OF TECHNOLOGY & MANAGEMENT			
FORMS / FORMATS (ISO 9001:2015)	Doc. No: FAF/L4	Release No. 5.0 Date: 01/07/2017	Revision No. 5.0 Date: 01/07/2017	Section: PP 04 Form No.: R/PP 04/04

DEPARTMENT OF MECHANICAL ENGINEERING

FEEDBACK FORM

Name of the Event	AUTODESK FUSION 360 SOFTWARE TRAINING
Date & Duration	23-03-2024 / 6hrs
Trainer Name	ABHISHEK SAJJAN Pinnacle Engineering ltd, Bangalore
Location	CAMD Lab, Mechanical Block, BITM

Note : Please give the event feedback on how well sessions met its objective (Indicate your response by circle)

SL.No	CONTENT	LOW				HIGH
1.	Relevance of the topic	1	2	3	4	(5)
2.	Level of topic understood	1	2	3	4	(5)
3.	Trainer guidance	1	2	3	4	(5)
4.	Complexity of drawings	1	2	3	4	(5)
5.	Overall training feedback	1	2	3	4	(5)

Any other suggestions/comments :

1. **What did you enjoy most today?**
   I learnt shortcut keys in Fusion 360
2. **What did you learn from today's session?**
   I learn today's session Autodesk Drawings & Exercise
3. **What you didn't like from today's session ?**
   ~~I learn~~
4. **Did the sessions meet your exxpections? YES/NO**
   Yes

Prepared by: **Dr. T. Machappa** Signature: Designation: **ISO Coordinator**	Approved by: **Dr. Yashvanth Bhupal** Signature: Designation: **Director**

8. Pictures/Images of the Event

The One-week Faculty Development Program was concluded with a vote of thanks by the Organisers. We thank the Chairman, Director, Principal, and HOD for providing the opportunity, support, and encouragement for the successful conduct of the program.

With Best Regards from the Organizers of FDP

Dr.Shivaramakrishna A

Dr.Pavan Kumar B K

Faculty Feedback

As Per the faculty feedback, the following are the concerns raised and corresponding actions taken. Some of the faculty members have raised concerns about up skilling knowledge in the area of Recent Advancement in Electric Vehicle Technologies among the faculty and students.

Action report:

The department has organized a 5-day national-level FDP from 24-07-2023 to 28-07-2023 on recent advancements in Electric Vehicle Technologies. A theory course on "Electric Vehicle Technology "and an ability enhancement course, "Modeling and simulation of Electric Vehicle System using MATLAB," have been introduced in the 6th-semester.

Graduate exit survey Feedback:

According to the graduate feedback, the following are the concerns raised and corresponding actions taken.

- Some of the graduates raised concerns that the students could not design/develop a component/process/algorithm as per the specified requirements at their workplace which is a lack of proficiency in the field of computer systems and programming languages and hands on experience.
- Also suggested to inculcate the soft skills among the students for the workplace.

Action taken:

The department has introduced Ability Enhancement Courses (AEC) related department specific viz. T & D using Sci lab (21EE581) and Modeling, Simulation of Electric Vehicle System Using MATLAB (21EE691) (Licensed version).These courses help to design/develop a component/process required at the workplace.
To improve the soft skills among the students a course, "professional skills for the workplace (22PSW47)"has been introduced which include communication skills, presentation skills and English language etc.

Employer Feedback

Concerns Raised:

Some of the employers raised concerns about the lack of proficiency to handle real-time issues, the technology used in design of the products as per the industrial needs.

Action taken:

To improve the proficiency in handling real-time issues, the technology required designing the products as per the industrial needs, 96 Students along with 2 faculties have been sent for Internship training

on "Future Technologies in E-mobility and Industry 4.O" COIMBATORE at KGI's TECH. CENTER from 09-02-2024 to 11-03-2024 in association with SPARK Technologies- Industrial Associates & Trainer. And arranged python and oops training in campus for three weeks from E Z training and technologies

Student Feedback:

Summarizing student feedback and corresponding actions taken to address concerns about the condition of the lab equipment in Electrical machine labs and control systems lab based on the feedback received

Concerns Raised:

- Students were reported issues related to the working condition of lab equipments.
- Errors were noted during experiments, particularly in Electrical machine lab and control systems lab.

Actions Taken:

- Equipment maintenance: Some equipment was under service during the feedback period.
- Service and procurement of new equipments: Some of the equipments were repaired and used in the Electrical machine labs. For control systems laboratory all the old experimental modules were replaced by new modules. Faculty members were advised to repeat the experiments with new modules.

Signature of the HOD

Signature of the Principal

Department of Electronics and Communication Engg.

Faculty Feedback

As per the faculty feedback the following are the concerns raised and corresponding actions taken

1. One of the faculties has raised the concern about the balance between lab and theory components

Action taken: Institute has set up new IPCC labs (Class and LAB are combined), for more than one subject which will help the faculty to deliver the content in a more effective way and students are benefitted the most.

Graduate exit survey Feedback

As per the graduate feedback the following are the concerns raised and corresponding actions taken

1. Many of the graduates raised the concern about the design Electronics and communication engineering systems, components or process by means of design experiences integrated throughout the professional content of the curriculum

Action taken: Department has revised the syllabus with respect to lab content, which includes the design based experiments for each lab. This enhances student ability towards the design of electronics and communication engineering systems.

Student Feedback

As per the student feedback the following are the concerns raised and corresponding actions taken

1. Faculties Mr. Prechand D R, Mrs. Sowbhagya, and Mr. Hemanth kumar have got feedback less than the benchmark which concerns about subject knowledge for particular subjects.

Action taken: Department has taken feedback for the 2nd time in at the end of the semester, and it is noticed that the feedback has been improved significantly.

Alumni survey Feedback

As per the graduate feedback the following are the concerns raised and corresponding actions taken

1. Many of the graduates raised the concern about the You are able to conduct investigations to resolve complex engineering issues and proficiency in selecting and utilizing modern engineering/1T tools effectively in the workplace.

Action taken: Department has procured Matlab campus wide licence. This enhances student ability towards the usage of modern engineering tools.

Signature of the HOD

Dept. of Electronics & Communication Engg.
Ballari Institute of Technology & Management
BELLARY

Signature of the Principal

Principal,
Ballari Institute of Technology & Management,
Ballari.

Department of Computer Science & Engg.

Action taken on StakeholdersFeedback

Employer Feedback

As per the employer survey feedback are the following are the concerns raised and corresponding action taken.

1. The employer has observed the lesser participation of the graduate in professional society activities such as seminars and conferences etc.

Action Report:

It is proposed in the department meeting held on 10-6-2022 to organize an invited talk/ Seminar on the related topic.

Faculty Feedback

As per the faculty feedback, the following are the concerns raised and corresponding actions taken.

1. One of the faculty has raised a concern about the requirement of the content/course on cyber security during revision of the syllabus.

Action report:

The institution has introduced a course on the introduction of cyber security in the new curriculum which is effective from 2022-2023.

Graduate Feedback

As per the graduate feedback the following are the concerns raised and corresponding action taken.

1. Request was made to conduct awareness session and training programs on software product development.

Action report:

It is discussed in the department meeting held on 28-03-2022 to conduct workshop on software product development from the industry experts to the students during the academic year 2022-23

Student Feedback

Action report:

All the faculty were given feedback which can meet the required benchmark, however,to upgrade teaching skills faculty where deputed for FDPS/Workshop.

Signature of the HOD

Signature of the Principal

Department of CSE(Data Science) Engineering

Faculty Feedback

As per the faculty feedback the following are the concerns raised and corresponding actions taken

1. One of the faculties has suggested to include the courses related to latest technology.

Action taken:

Department has introduced new courses like NoSql, DevOps, Natural Language Processing, Data Visualization and Block chain Technology for 3rd year students, which will help the students to aware and understand latest technologies and students are benefitted the most.

Student feedback

As per the student feedback the following are the concerns raised and corresponding actions taken.

1. One of the faculties has got feedback less than the benchmark which concerns about audibility/clarity and interaction of staff with students for particular subjects.

Action Taken: Department has procured speaker and mike to improve the audibility/clarity. Head of the department has interacted with faculty regarding above said points and suggested to improve the same.

Sign of the HOD

Dr. ARADHANA D
Professor and Head
Dept. of CSE (Data Science)
Ballari Institute of Technology & Management,
Ballari.

Sign of the Principal

BALLARI INSTITUTE OF TECHNOLOGY AND MANAGEMENT

DEPARTMENT OF MECHANICAL ENGINEERING

Date: 08-04-2024

CIRCULAR

It is here by informed to all the 6th semester A, B & C -Section Mechanical Engineering students to attend the Industrial visit to KPCL, Ballari Thermal Power station, kuditini scheduled on **25-06-2023 to 27-04-2024** without fail. The students and faculty will be permitted only when satisfying the below mentioned conditions.

1. Should wear ID card compulsorily.
2. Should come with uniform and shoes.

Schedule

Sl No	Section	Date & Time
1	VI_A sec	25-06-2024, @ 9:00 AM
2	VI B sec	26-06-2024\, @ 9:00 AM
3	VI C sec	27-06-2024, @ 9:00 AM

In chargers

Dr. SHEKAR .K

Dr. BANAKARA NAGARAJ

HOD

Dr. V. Venkata Ramana

KPCL
ಕರ್ನಾಟಕ ವಿದ್ಯುತ್ ನಿಗಮ ನಿಯಮಿತ
KARNATAKA POWER CORPORATION LTD.,
(A premier power generating company of Government of Karnataka)
CIN U85110KA1970SGC001919

ಸಂಖ್ಯೆ:ಎಚ್ ಎ6 ಎ ಸಿಸಿ: 1222. ದಿನಾಂಕ:18.06.2024

ಪ್ರಾಂಶುಪಾಲರು,
ಬಳ್ಳಾರಿ ಇನ್ಸ್‌ಟಿಟ್ಯೂಟ್ ಆಫ್ ಟೆಕ್ನಾಲಜಿ & ಮ್ಯಾನೇಜ್‌ಮೆಂಟ್,
ನಂ.873/2, "ಜ್ಞಾನ ಗಂಗೋತ್ರಿ" ಕ್ಯಾಂಪಸ್,
ಬಳ್ಳಾರಿ-ಹೊಸಪೇಟೆ ರೋಡ್, ಆಲಿಪುರ ಹತ್ತಿರ,
ಬಳ್ಳಾರಿ-583104.
ಮೊಬೈಲ್: 99024-99388

ಮಾನ್ಯರೆ,

ವಿಷಯ: ಬಳ್ಳಾರಿ ಶಾಖೋತ್ಪನ್ನ ವಿದ್ಯುತ್ ಕೇಂದ್ರವನ್ನು ವೀಕ್ಷಿಸಲು ಅನುಮತಿ – ಕುರಿತು.
ಉಲ್ಲೇಖ: ತಮ್ಮ ಪತ್ರ ದಿನಾಂಕ: 12.06.2024

****

ಯೋಜನಾ ಪ್ರದೇಶಗಳನ್ನು ಸಂದರ್ಶಿಸಲು ತಾವು ಬರೆದುಕೊಂಡ ಉಲ್ಲೇಖ ಪತ್ರದಲ್ಲಿ ತಿಳಿಸಿರುವಂತೆ ಬಳ್ಳಾರಿ ಜಿಲ್ಲೆ ಕುಡುತಿನಿಯಲ್ಲಿರುವ **ಬಳ್ಳಾರಿ ಶಾಖೋತ್ಪನ್ನ ವಿದ್ಯುತ್ ಕೇಂದ್ರವನ್ನು** ವೀಕ್ಷಿಸಲು **ದಿನಾಂಕ:25.06.2024** ರಂದು ನಿಮ್ಮ ಸಂಸ್ಥೆಯ ಮೆಕ್ಯಾನಿಕಲ್ ಇಂಜಿನಿಯರಿಂಗ್ ವಿಭಾಗದ 60 ವಿದ್ಯಾರ್ಥಿಗಳು ಹಾಗೂ 04 ಉಪನ್ಯಾಸಕರು/ಸಿಬ್ಬಂದಿಗಳು ಸೇರಿ ಒಟ್ಟು 64 ಸದಸ್ಯರಿಗೆ ವೀಕ್ಷಿಸಲು ಈ ಮೂಲಕ ಅನುಮತಿ ನೀಡಲಾಗಿದೆ. **[ಭೇಟಿಯ ಸಮಯ: ಬೆಳಿಗ್ಗೆ 9.00 ಘಂಟೆಯಿಂದ 12.00 ಘಂಟೆಯವರೆಗೆ ಮತ್ತು ಮಧ್ಯಾಹ್ನ 2.00 ಘಂಟೆಯಿಂದ 4.30 ಘಂಟೆಯವರೆಗೆ ಮಾತ್ರ – ಶನಿವಾರ ಬೆಳಿಗ್ಗೆ ಮಾತ್ರ].**

ಈ ಅನುಮತಿಯು ಕೆಳಗಿನ ನಿಬಂಧನೆಗಳಿಗೆ ಒಳಪಟ್ಟಿರುತ್ತದೆ.

1. ಸಂಸ್ಥೆಯ ಮುಖ್ಯಸ್ಥರಿಂದ ಪಡೆದಿರುವ ಗುರುತಿನ ಚೀಟಿಯನ್ನು (Identity card) ಹಾಜರು ಪಡಿಸಲು ಸೂಚಿಸಲಾಗಿದೆ. ಯೋಜನಾ ಪ್ರದೇಶಗಳಿಗೆ ಭೇಟಿ ನೀಡುವವರು 2 ಬಾರಿ ಕೋವಿಡ್ ಲಸಿಕೆಯನ್ನು ಪಡೆದ ಬಗ್ಗೆ ದಾಖಲೆಗಳನ್ನು ಒದಗಿಸುವುದು.
2. ಪಟ್ಟಿಯಲ್ಲಿರುವವರನ್ನು ಭಾರತೀಯ ಪೌರರೆಂದು ಧೃಢೀಕರಿಸಬೇಕು. ಇಲ್ಲದ ಪಕ್ಷದಲ್ಲಿ ಅನುಮತಿಯನ್ನು ನಿರಾಕರಿಸಲಾಗುವುದು. ವಿದೇಶಿಯರಿಗೆ ಯೋಜನಾ ಪ್ರದೇಶಗಳಿಗೆ ಅನುಮತಿ ನೀಡಲಾಗುವುದಿಲ್ಲ.
3. ವಿಡಿಯೋ/ಮೊಬೈಲ್/ಕ್ಯಾಮರಗಳನ್ನು ಯೋಜನಾ ಪ್ರದೇಶದ ಒಳಗೆ ತೆಗೆದುಕೊಂಡು ಹೋಗುವುದನ್ನು ಹಾಗೂ ಛಾಯಾಚಿತ್ರಗಳನ್ನು, ಸೆಲ್ಫಿ ತೆಗೆಯುವುದನ್ನು ನಿಷೇಧಿಸಲಾಗಿದ.
4. ಯೋಜನಾ ಪ್ರದೇಶದಲ್ಲಿ ಆಹಾರ ಸ್ವೀಕರಿಸುವುದು, ಮನೋರಂಜನೆ ಮತ್ತು ಖಾಸಗಿ ವಾಹನಗಳಿಗೆ ಅವಕಾಶವಿರುವುದಿಲ್ಲ.
5. ಯೋಜನಾ ಪ್ರದೇಶದಲ್ಲಿ ನಿಗಮದ ಯಾವುದೇ ಆಸ್ತಿ-ಪಾಸ್ತಿಗೆ ಹಾನಿ ಉಂಟುಮಾಡುವಂತಿಲ್ಲ. ಒಂದು ವೇಳೆ ಪ್ರಾಣ ಹಾನಿ ಮತ್ತು ಯಾವುದೇ ಅಹಿತಕರ ಘಟನೆಗಳು ಸಂಭವಿಸಿದಲ್ಲಿ ಈ ಘಟನೆಗಳಿಗೆ ಸಂಸ್ಥೆಯ/ಕಾಲೇಜಿನ ಮುಖ್ಯಸ್ಥರು ಸಂಪೂರ್ಣ ಜವಾಬ್ದಾರರಾಗಿರುತ್ತೇವೆಂದು ಹಾಗೂ ನಿಗಮದ ಆಸ್ತಿ-ಪಾಸ್ತಿಗೆ ಧಕ್ಕೆ ಉಂಟು ಮಾಡಿದಲ್ಲಿ ಸಂಪೂರ್ಣ ವೆಚ್ಚವನ್ನು ಭರಿಸಿ ಕೊಡಲಾಗುವುದೆಂದು ಪ್ರಮಾಣ ಪತ್ರದ ಮುಚ್ಚಳಿಕೆಯನ್ನು ಭೇಟಿ ನೀಡುವ ಸಂದರ್ಭದಲ್ಲಿ ಯೋಜನಾ ಪ್ರದೇಶದ ಮುಖ್ಯಸ್ಥರುಗಳಿಗೆ ಕಡ್ಡಾಯವಾಗಿ ನೀಡತಕ್ಕದ್ದು. ನಿಗಮ ಯಾವುದೇ ರೀತಿಯಲ್ಲಿ ಜವಾಬ್ದಾರಿಯನ್ನು ಹೊಂದಿರುವುದಿಲ್ಲ.
ಕೋವಿಡ್-19 ನಿಯಮಾವಳಿಗಳನ್ನು ಪಾಲಿಸಲು ಕೋರಲಾಗಿದೆ.

ಸಂದರ್ಶಿಸುವ ತಂಡವು ಯೋಜನಾ ಪ್ರದೇಶಗಳನ್ನು ಪ್ರವೇಶಿಸಿದ ನಂತರ ಕಾರ್ಯನಿರ್ವಾಹಕ ನಿರ್ದೇಶಕರು (ಬಿಟಿಪಿಎಸ್) ಕೆಪಿಸಿಎಲ್, ಕುಡುತಿನಿ-583 152, ಬಳ್ಳಾರಿ ಜಿಲ್ಲೆ, ದೂರವಾಣಿ ಸಂಖ್ಯೆ: 08392-288608 ಇವರನ್ನು ಮುಂದಿನ ಸಹಕಾರಕ್ಕಾಗಿ ಸಂಪರ್ಕಿಸುವುದು.

ವಂದನೆಗಳೊಂದಿಗೆ,

ತಮ್ಮ ನಿಷ್ಠ,
ಕರ್ನಾಟಕ ವಿದ್ಯುತ್ ನಿಗಮ ನಿಯಮಿತದ ಪರವಾಗಿ,
ಕೆ.ರವೀಂದ್ರಕುಮಾರ್
ಪ್ರಧಾನ ವ್ಯವಸ್ಥಾಪಕರು (ಕಾರ್ಪೊರೇಟ್ ಕಮ್ಯುನಿಕೇಷನ್ಸ್)

BITM, BELLARY.
INWARD
No 125
Date 20.06.24
Sign
To

KPCL
ಕರ್ನಾಟಕ ವಿದ್ಯುತ್ ನಿಗಮ ನಿಯಮಿತ
KARNATAKA POWER CORPORATION LTD.,
(A premier power generating company of Government of Karnataka)
CIN U85110KA1970SGC001919

ಸಂಖ್ಯೆ: ಎ6 ಎ ಸಿಸಿ: 2220 ದಿನಾಂಕ:18.06.2024

ನಿರ್ದೇಶಕರು,
ಬಳ್ಳಾರಿ ಇನ್ಸ್‌ಟಿಟ್ಯೂಟ್ ಆಫ್ ಟೆಕ್ನಾಲಜಿ & ಮ್ಯಾನೇಜ್‌ಮೆಂಟ್,
ನಂ.873/2, "ಜ್ಞಾನ ಗಂಗೋತ್ರಿ" ಕ್ಯಾಂಪಸ್,
ಬಳ್ಳಾರಿ-ಹೊಸಪೇಟೆ ರೋಡ್, ಆಲಿಪುರ ಹತ್ತಿರ,
ಬಳ್ಳಾರಿ-583104.
ಮೊಬೈಲ್: 99024-99388

ಮಾನ್ಯರೆ,

ವಿಷಯ: ಬಳ್ಳಾರಿ ಶಾಖೋತ್ಪನ್ನ ವಿದ್ಯುತ್ ಕೇಂದ್ರವನ್ನು ವೀಕ್ಷಿಸಲು ಅನುಮತಿ – ಕುರಿತು.
ಉಲ್ಲೇಖ: ತಮ್ಮ ಪತ್ರ ದಿನಾಂಕ: 12.06.2024

*****

ಯೋಜನಾ ಪ್ರದೇಶಗಳನ್ನು ಸಂದರ್ಶಿಸಲು ತಾವು ಬರೆದುಕೊಂಡ ಉಲ್ಲೇಖ ಪತ್ರದಲ್ಲಿ ತಿಳಿಸಿರುವಂತೆ ಬಳ್ಳಾರಿ ಜಿಲ್ಲೆ ಮುದುತಿನಿಯಲ್ಲಿರುವ ಬಳ್ಳಾರಿ ಶಾಖೋತ್ಪನ್ನ ವಿದ್ಯುತ್ ಕೇಂದ್ರವನ್ನು ವೀಕ್ಷಿಸಲು ದಿನಾಂಕ:26.06.2024 ರಂದು ನಿಮ್ಮ ಸಂಸ್ಥೆಯ ಮೆಕ್ಯಾನಿಕಲ್ ಇಂಜಿನಿಯರಿಂಗ್ ವಿಭಾಗದ 60 ವಿದ್ಯಾರ್ಥಿಗಳು ಹಾಗೂ 04 ಉಪನ್ಯಾಸಕರು/ಸಿಬ್ಬಂದಿಗಳು ಸೇರಿ ಒಟ್ಟು 64 ಸದಸ್ಯರಿಗೆ ವೀಕ್ಷಿಸಲು ಈ ಮೂಲಕ ಅನುಮತಿ ನೀಡಲಾಗಿದೆ. **[ಭೇಟಿಯ ಸಮಯ: ಬೆಳಿಗ್ಗೆ 9.00 ಘಂಟೆಯಿಂದ 12.00 ಘಂಟೆಯವರೆಗೆ ಮತ್ತು ಮಧ್ಯಾಹ್ನ 2.00 ಘಂಟೆಯಿಂದ 4.30 ಘಂಟೆಯವರೆಗೆ ಮಾತ್ರ – ಶನಿವಾರ ಬೆಳಿಗ್ಗೆ ಮಾತ್ರ].**

ಈ ಅನುಮತಿಯು ಕೆಳಗಿನ ನಿಬಂಧನೆಗಳಿಗೆ ಒಳಪಟ್ಟಿರುತ್ತದೆ.

1. ಸಂಸ್ಥೆಯ ಮುಖ್ಯಸ್ಥರಿಂದ ಪಡೆದಿರುವ ಗುರುತಿನ ಚೀಟಿಯನ್ನು (Identity card) ಹಾಜರು ಪಡಿಸಲು ಸೂಚಿಸಲಾಗಿದೆ. ಯೋಜನಾ ಪ್ರದೇಶಗಳಿಗೆ ಭೇಟಿ ನೀಡುವವರು 2 ಡಾಸ್ ಕೋವಿಡ್ ಲಸಿಕೆಯನ್ನು ಪಡೆದ ಬಗ್ಗೆ ದಾಖಲೆಗಳನ್ನು ಒದಗಿಸುವುದು.
2. ಪಟ್ಟಿಯಲ್ಲಿರುವವರನ್ನು ಭಾರತೀಯ ಪೌರರೆಂದು ಧೃಢೀಕರಿಸಬೇಕು. ಇಲ್ಲದ ಪಕ್ಷದಲ್ಲಿ ಅನುಮತಿಯನ್ನು ನಿರಾಕರಿಸಲಾಗುವುದು. ವಿದೇಶಿಯರಿಗೆ ಯೋಜನಾ ಪ್ರದೇಶಗಳಿಗೆ ಅನುಮತಿ ನೀಡಲಾಗುವುದಿಲ್ಲ.
3. ವಿಡಿಯೋ/ಮೊಬೈಲ್/ಕ್ಯಾಮರಗಳನ್ನು ಯೋಜನಾ ಪ್ರದೇಶದ ಒಳಗೆ ತೆಗೆದುಕೊಂಡು ಹೋಗುವುದನ್ನು ಹಾಗೂ ಛಾಯಾಚಿತ್ರಗಳನ್ನು, ಸೆಲ್ಫಿ ತೆಗೆಯುವುದನ್ನು ನಿಷೇದಿಸಲಾಗಿದೆ.
4. ಯೋಜನಾ ಪ್ರದೇಶದಲ್ಲಿ ಆಹಾರ ಸ್ವೀಕರಿಸುವುದು, ಮನೋರಂಜನೆ ಮತ್ತು ಖಾಸಗಿ ವಾಹನಗಳಿಗೆ ಅವಕಾಶವಿರುವುದಿಲ್ಲ.
5. ಯೋಜನಾ ಪ್ರದೇಶದಲ್ಲಿ ನಿಗಮದ ಯಾವುದೇ ಆಸ್ತಿ-ಪಾಸ್ತಿಗೆ ಹಾನಿ ಉಂಟುಮಾಡುವಂತಿಲ್ಲ. ಒಂದು ವೇಳೆ ಪ್ರಾಣ ಹಾನಿ ಮತ್ತು ಯಾವುದೇ ಅಹಿತಕರ ಘಟನೆಗಳು ಸಂಭವಿಸಿದಲ್ಲಿ ಈ ಘಟನೆಗಳಿಗೆ ಸಂಸ್ಥೆಯ/ಕಾಲೇಜಿನ ಮುಖ್ಯಸ್ಥರು ಸಂಪೂರ್ಣ ಜವಾಬ್ದಾರರಾಗಿರುತ್ತೇವೆಂದು ಹಾಗೂ ನಿಗಮದ ಆಸ್ತಿ-ಪಾಸ್ತಿಗೆ ಧಕ್ಕೆ ಉಂಟು ಮಾಡಿದಲ್ಲಿ ಸಂಪೂರ್ಣ ವೆಚ್ಚವನ್ನು ಭರಿಸಿ ಕೊಡಲಾಗುವುದೆಂದು ಪ್ರಮಾಣ ಪತ್ರದ ಮುಚ್ಚಳಿಕೆಯನ್ನು ಭೇಟಿ ನೀಡುವ ಸಂದರ್ಭದಲ್ಲಿ ಯೋಜನಾ ಪ್ರದೇಶದ ಮುಖ್ಯಸ್ಥರುಗಳಿಗೆ ಕಡ್ಡಾಯವಾಗಿ ನೀಡತಕ್ಕದ್ದು. ನಿಗಮ ಯಾವುದೇ ರೀತಿಯಲ್ಲಿ ಜವಾಬ್ದಾರಿಯನ್ನು ಹೊಂದಿರುವುದಿಲ್ಲ. ಕೋವಿಡ್-19 ನಿಯಮಾವಳಿಗಳನ್ನು ಪಾಲಿಸಲು ಕೋರಲಾಗಿದೆ.

ಸಂದರ್ಶಿಸುವ ತಂಡವು ಯೋಜನಾ ಪ್ರದೇಶಗಳನ್ನು ಪ್ರವೇಶಿಸಿದ ನಂತರ ಕಾರ್ಯನಿರ್ವಾಹಕ ನಿರ್ದೇಶಕರು (ಜಿಟಿಟಿಎಸ್) ಕೆಪಿಸಿಎಲ್, ಕುಡುತಿನಿ-583 152, ಬಳ್ಳಾರಿ ಜಿಲ್ಲೆ, ದೂರವಾಣಿ ಸಂಖ್ಯೆ: 08392-288608 ಇವರನ್ನು ಮುಂದಿನ ಸಹಕಾರಕ್ಕಾಗಿ ಸಂಪರ್ಕಿಸುವುದು.

ವಂದನೆಗಳೊಂದಿಗೆ.

BITM, BELLARY.
INWARD
No 125
Date 20.06.24
Sign
To

ತಮ್ಮ ವಿಶ್ವಾಸಿ,
ಕರ್ನಾಟಕ ವಿದ್ಯುತ್ ನಿಗಮ ನಿಯಮಿತದ ಪರವಾಗಿ
ಶ್ರೀ. ಶಶಿಂದ್ರ ಕುಮಾರ್
ಉಪ ಪ್ರಧಾನ ವ್ಯವಸ್ಥಾಪಕರು (ಕಾರ್ಪೊರೇಟ್ ಕಮ್ಯುನಿಕೇಷನ್)

'ಶಕ್ತಿ ಭವನ', ನಂ. 82, ರೇಸ್ ಕೋರ್ಸ್ ರಸ್ತೆ, ಬೆಂಗಳೂರು-560 001. ದೂರವಾಣಿ : 080-2225 6568 ಫ್ಯಾಕ್ಸ್ : 080-2225 2144
'Shakthi Bhavan', # 82, Race Course Road, Bengaluru-560 001. Tel. : 080-2225 6568 Fax : 080-2225 2144
E-mail : kpclcccmpa@gmail.com Website : www.karnatakapower.com

KPCL
ಕರ್ನಾಟಕ ವಿದ್ಯುತ್ ನಿಗಮ ನಿಯಮಿತ
KARNATAKA POWER CORPORATION LTD.,
(A premier power generating company of Government of Karnataka)
CIN U85110KA1970SGC001919

ನಂಬರ್/ಎಂಎ ಎ6 ಎ ಸಿಸಿ: 1221 ದಿನಾಂಕ:18.06.2024

ಪ್ರಾಂಶುಪಾಲರು,
ಬಳ್ಳಾರಿ ಇನ್ಸ್‌ಟಿಟ್ಯೂಟ್ ಆಫ್ ಟೆಕ್ನಾಲಜಿ & ಮ್ಯಾನೇಜ್‌ಮೆಂಟ್,
ಸಂ.873/2, "ಜ್ಞಾನ ಗಂಗೋತ್ರಿ" ಕ್ಯಾಂಪಸ್,
ಬಳ್ಳಾರಿ-ಮೊಸಪೇಟೆ ರೋಡ್, ಆಲಿಪುರ ಹತ್ತಿರ,
ಬಳ್ಳಾರಿ-583104.
ಮೊಬೈಲ್: 99024-99388

ಮಾನ್ಯರೆ,

ವಿಷಯ: ಬಳ್ಳಾರಿ ಶಾಖೋತ್ಪನ್ನ ವಿದ್ಯುತ್ ಕೇಂದ್ರವನ್ನು ವೀಕ್ಷಿಸಲು ಅನುಮತಿ -- ಬಗ್ಗೆ.
ಉಲ್ಲೇಖ: ತಮ್ಮ ಪತ್ರ ದಿನಾಂಕ: 12.06.2024

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ಯೋಜನಾ ಪ್ರದೇಶಗಳನ್ನು ಸಂದರ್ಶಿಸಲು ತಾವು ಬರೆದುಕೊಂಡ ಉಲ್ಲೇಖ ಪತ್ರದಲ್ಲಿ ತಿಳಿಸಿರುವಂತೆ ಬಳ್ಳಾರಿ ಜಿಲ್ಲೆ ಮೋಕಾನಿಯಲ್ಲಿರುವ **ಬಳ್ಳಾರಿ ಶಾಖೋತ್ಪನ್ನ ವಿದ್ಯುತ್ ಕೇಂದ್ರವನ್ನು ವೀಕ್ಷಿಸಲು ದಿನಾಂಕ:27.06.2024** ರಂದು ನಿಮ್ಮ ಸಂಸ್ಥೆಯ ಮೆಕ್ಯಾನಿಕಲ್ ಇಂಜಿನಿಯರಿಂಗ್ ವಿಭಾಗದ 60 ವಿದ್ಯಾರ್ಥಿಗಳು ಹಾಗೂ 04 ಉಪನ್ಯಾಸಕರು/ಸಿಬ್ಬಂದಿಗಳು ಸೇರಿ ಒಟ್ಟು 64 ಸದಸ್ಯರಿಗೆ ವೀಕ್ಷಿಸಲು ಈ ಮೂಲಕ ಅನುಮತಿ ನೀಡಲಾಗಿದೆ. **[ಭೇಟಿಯ ಸಮಯ: ಬೆಳಿಗ್ಗೆ 9.00 ಘಂಟೆಯಿಂದ 12.00 ಘಂಟೆಯವರೆಗೆ ಮತ್ತು ಮಧ್ಯಾಹ್ನ 2.00 ಘಂಟೆಯಿಂದ 4.30 ಘಂಟೆಯವರೆಗೆ ಮಾತ್ರ – ಶನಿವಾರ ಬೆಳಿಗ್ಗೆ ಮಾತ್ರ].**

ಈ ಅನುಮತಿಯು ಕೆಳಗಿನ ನಿಬಂಧನೆಗಳಿಗೆ ಒಳಪಟ್ಟಿರುತ್ತದೆ.

1. ಸಂಸ್ಥೆಯ ಮುಖ್ಯಸ್ಥರಿಂದ ಪಡೆದಿರುವ ಗುರುತಿನ ಚೀಟಿಯನ್ನು (Identity card) ಹಾಜರು ಪಡಿಸಲು ಸೂಚಿಸಲಾಗಿದೆ. ಯೋಜನಾ ಪ್ರದೇಶಗಳಿಗೆ ಭೇಟಿ ನೀಡುವವರು 2 ಬಾರಿ ಕೋವಿಡ್ ಲಸಿಕೆಯನ್ನು ಪಡೆದ ಬಗ್ಗೆ ದಾಖಲೆಗಳನ್ನು ಒದಗಿಸುವುದು.
2. ಪಟ್ಟಿಯಲ್ಲಿರುವವರನ್ನು ಭಾರತೀಯ ಪೌರರೆಂದು ದೃಢೀಕರಿಸಬೇಕು. ಇಲ್ಲದ ಪಕ್ಷದಲ್ಲಿ ಅನುಮತಿಯನ್ನು ನಿರಾಕರಿಸಲಾಗುವುದು. ವಿದೇಶಿಯರಿಗೆ ಯೋಜನಾ ಪ್ರದೇಶಗಳಿಗೆ ಅನುಮತಿ ನೀಡಲಾಗುವುದಿಲ್ಲ.
3. ವಿಡಿಯೋ/ಮೊಬೈಲ್/ಕ್ಯಾಮರಗಳನ್ನು ಯೋಜನಾ ಪ್ರದೇಶದ ಒಳಗೆ ತೆಗೆದುಕೊಂಡು ಹೋಗುವುದನ್ನು ಹಾಗೂ ಛಾಯಾಚಿತ್ರಗಳನ್ನು, ಸೆಲ್ಫಿ ತೆಗೆಯುವುದನ್ನು ನಿಷೇದಿಸಲಾಗಿದೆ.
4. ಯೋಜನಾ ಪ್ರದೇಶದಲ್ಲಿ ಆಹಾರ ಸ್ವೀಕರಿಸುವುದು, ಮನೋರಂಜನೆ ಮತ್ತು ಖಾಸಗಿ ವಾಹನಗಳಿಗೆ ಅವಕಾಶವಿರುವುದಿಲ್ಲ.
5. ಯೋಜನಾ ಪ್ರದೇಶದಲ್ಲಿ ನಿಗಮದ ಯಾವುದೇ ಆಸ್ತಿ-ಪಾಸ್ತಿಗೆ ಹಾನಿ ಉಂಟುಮಾಡುವಂತಿಲ್ಲ ಒಂದು ವೇಳೆ ಹಾಗೆ ಹಾನಿ ಮತ್ತು ಯಾವುದೇ ಅಹಿತಕರ ಘಟನೆಗಳು ಸಂಭವಿಸಿದಲ್ಲಿ ಈ ಘಟನೆಗಳಿಗೆ ಸಂಸ್ಥೆಯ/ಕಾಲೇಜಿನ ಮುಖ್ಯಸ್ಥರು ಸಂಪೂರ್ಣ ಜವಾಬ್ದಾರರಾಗಿರುತ್ತೇವೆಂದು ಹಾಗೂ ನಿಗಮದ ಆಸ್ತಿ-ಪಾಸ್ತಿಗೆ ಧಕ್ಕೆ ಉಂಟು ಮಾಡಿದಲ್ಲಿ ಸಂಪೂರ್ಣ ವೆಚ್ಚವನ್ನು ಭರಿಸಿ ಕೊಡಲಾಗುವುದೆಂದು ಪ್ರಮಾಣ ಪತ್ರದ ಮುಚ್ಚಳಿಕೆಯನ್ನು ಭೇಟಿ ನೀಡುವ ಸಂದರ್ಭದಲ್ಲಿ ಯೋಜನಾ ಪ್ರದೇಶದ ಮುಖ್ಯಸ್ಥರುಗಳಿಗೆ ಕಡ್ಡಾಯವಾಗಿ ನೀಡತಕ್ಕದ್ದು. ನಿಗಮ ಯಾವುದೇ ರೀತಿಯಲ್ಲಿ ಜವಾಬ್ದಾರಿಯನ್ನು ಹೊಂದಿರುವುದಿಲ್ಲ.
6. ಕೋವಿಡ್-19 ನಿಯಮಾವಳಿಗಳನ್ನು ಪಾಲಿಸಲು ಕೋರಲಾಗಿದೆ.

ಸಂದರ್ಶಿಸುವ ತಂಡವು ಯೋಜನಾ ಪ್ರದೇಶಗಳನ್ನು ಪ್ರವೇಶಿಸಿದ ನಂತರ ಕಾರ್ಯನಿರ್ವಾಹಕ ನಿರ್ದೇಶಕರು (ಬಿಟಿಪಿಎಸ್), ಕೆಪಿಸಿಎಲ್, ಕುಡುತಿನಿ-583 152, ಬಳ್ಳಾರಿ ಜಿಲ್ಲೆ, ದೂರವಾಣಿ ಸಂಖ್ಯೆ: 08392-288608 ಇವರನ್ನು ಮುಂದಿನ ಸಹಕಾರಕ್ಕಾಗಿ ಸಂಪರ್ಕಿಸುವುದು.

ವಂದನೆಗಳೊಂದಿಗೆ,

ತಮ್ಮ ವಿಶ್ವಾಸಿ,
ಕರ್ನಾಟಕ ವಿದ್ಯುತ್ ನಿಗಮ ನಿಯಮಿತದ ಪರವಾಗಿ,
ಸಹಿ/-
ಹಿರಿಯ ಪ್ರಧಾನ ವ್ಯವಸ್ಥಾಪಕರು (ಕಾರ್ಪೊರೇಟ್ ಕಮ್ಯುನಿಕೇಷನ್ಸ್)

BALLARI INSTITUTE OF TECHNOLOGY & MANAGEMENT

Autonomous Institute under VTU, Belagavi | Approved by AICTE, New Delhi | Recognized by Govt. of Karnataka

BE/B.Tech. Scheme of Teaching and Examinations
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2022-23)

MECHANICAL ENGINEERING

Scheme of Teaching and Evaluation for B.E Programs
With effect from the academic year 2021-22
Total Credits for B.E.: 160
Credits Distribution as per NEP 2020

SEM	HS	BS	ES	PC	PE	AEC	OE	PW	INT	SE	UHV	TOTAL
1	2	7	10	-	-	1	-	-	-	-	-	20
2	2	7	10	-	-	1	-	-	-	-	-	20
3	1	3	-	12	-	2	-	-	-	-	-	18
4	1	3	-	12	-	3	-	-	2	-	1	22
5	1	-	-	11	3	2	3	-	-	-	-	20
6	3	-	-	8	3	1	3	2	2	-	-	22
7	-	-	-	7	3	-	3	8	-	-	-	21
8	-	-	-	3	-	-	-	-	13	1	-	17
TOTAL	**10**	**20**	**20**	**53**	**9**	**10**	**9**	**10**	**17**	**1**	**1**	**160**

Sl. No.	Course Area	Credit Distribution
1.	Humanities Social Sciences including Management (HS)	10
2	Basic Sciences (BS)	20
3.	Engineering Sciences (ES)	20
4.	Professional Core (PC)	53
5.	Professional Electives (PE)	09
6.	Ability Enhancement Course (AEC)	10
7.	Open Electives	09
8.	Project Work (Mini/Major)	10
9.	Internship (INT)	17
10.	Seminar (SE)	01
11.	Universal Human Values (UHV)	01
12.	Mandatory Non-Credit Course (MNC)	-
	Total	**160**
The above is based on the VTU guidelines and the AICTE Model Curriculum		

V Semester

Scheme of Teaching and Examination 2022-23

Sl. No.	Course category	Course Code	Course	BOS / Teaching Department	BOE / Paper Setting Board	Teaching Hours per Week			Credits	Duration of Exam	Marks		
						L	T	P			CIE	SEE	Total
01	PCC	21ME51	**Thermo fluid Engineering**	Concerned Department	Concerned Board	3	0	0	3	3	50	50	100
02	PCC	21ME52	**Theory of Machines**	Concerned Department	Concerned Board	3	0	0	3	3	50	50	100
03	PCC	21ME53	**Production Technology-II**	Concerned Department	Concerned Board	3	0	0	3	3	50	50	100
04	PE	21ME54X	**Professional Elective – 1**	Concerned Department	Concerned Board	3	0	0	3	3	50	50	100
05	OE	21ME55X	**Open Elective - 1**	Other departments offering the course	Other departments offering the course	3	0	0	3	3	50	50	100
06	PCC	21MEL56	**Thermal Engineering Lab (FM+EC)**	Concerned Department	Concerned Board	0	0	2	1	3	50	50	100
07	PCC	21MEL57	**Machine shop Practice Lab**	Concerned Department	Concerned Board	0	0	2	1	3	50	50	100
08	AEC	21ADA580	**Advanced Aptitude**	Humanities	Humanities	1	0	0	1	2	50	50	100
09	AEC	21XX581	**Department Specific AEC**	Concerned Department	Concerned Board	1	0	0	1	2	50	50	100
10	HS	21ENV59	**Environmental Studies**	Humanities	Humanities	1	0	0	1	2	50	50	100
		Total							**20**		**500**	**500**	**1000**

Professional Elective – 1		
1	21ME541	**Composite Materials**
2	21ME542	**Production Operation Management**
3	21ME543	**Hydraulics and Pneumatics**

Professional Elective Courses (PE): A professional elective (PE) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trends and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum student strength for offering professional electives is 10. However, this condition shall not be applicable to cases where the admission to the program is less than 10.

Open Elective -1		
1	21ME551	**Engineering Economics**
2	21ME552	**Energy and Environment**
3	21ME553	**Total Quality Management**
4	21ME554	**Non-Conventional Energy Sources**

Open Elective Courses: Students belonging to a particular stream of Engineering and Technology are not entitled for the open electives offered by their parent Department. However, they can opt an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. Selection of an open elective shall not be allowed if,

- The candidate has studied the same course during the previous semesters of the program.
- The syllabus content of open electives is similar to that of the Departmental core courses or professional electives.
- A similar course, under any category, is prescribed in the higher semesters of the program.

Department Specific AEC	
21ME581	**3D Printing Lab**

VI Semester

Sl. No.	Couse category	Course Code	Course	BOS / Teaching Department	BOE / Paper Setting Board	Teaching Hours per Week			Credits	Duration of Exam	Marks		
						L	T	P			CIE	SEE	Total
01	***HSMC***	21ME61	Management and Entrepreneurship	Humanities /Concerned Department	Humanities /Concerned Board	2	2	0	3	3	50	50	100
02	PCC	21ME62	**Machine Design**	Concerned Department	Concerned Board	2	2	0	3	3	50	50	100
03	PCC	21ME63	**Heat Transfer**	Concerned Department	Concerned Board	2	2	0	3	3	50	50	100
04	PE	21ME64X	Professional Elective – 2	Concerned Department	Concerned Board	2	2	0	3	3	50	50	100
05	OE	21ME65X	Open Elective - 2	Other departments offering the course	Other departments offering the course	2	2	0	3	3	50	50	100
06	PCC	21MEL66	**Design Lab**	Concerned Department	Concerned Board	0	0	3	1	3	50	50	100
07	PCC	21MEL67	**HT Lab**	Concerned Department	Concerned Board	0	0	2	1	3	50	50	100
08	PW	21MN68	Mini Project	Concerned Department	Concerned Board	Two contact hours /week for interaction between the faculty and students			2	3	50	50	100
09	AEC	21ME690/ 690A/690 B	Ability Enhancement Course	Concerned Department	Concerned Board	0	2	0	1	1	50	50	100
10	INT	21INT691	Summer Internship-II	Completed during the intervening period of IV and V semesters.					2	---	100	-	100
								Total	**22**		**550**	**450**	**1000**

Professional Elective – 2		
1	21ME641	Non-Traditional Machining
2	21ME642	Work Study and Ergonomics
3	21ME643	Mechatronics
4	21ME644	Additive Manufacturing

Open Elective -2		
1	21ME651	Autonomous Vehicles
2	21ME652	Supply Chain Management
3	21ME653	Industrial Safety
4	21ME654	Work Study and Ergonomics

Department Specific AEC		
1	21ME690	Finite Element Analysis Lab
2	21ME690A	Spread Sheets for Engineers
3	21ME690B	Introduction to MAT LAB

SEMESTER: V

Course Name**: THERMO FLUID ENGINEERING**

Course Code	**21ME51**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**2:2:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Pre-requisites: Knowledge of Basic sciences**,** Fluid mechanics, Mathematics.

Course objectives:

1. Understand typical design of Turbo machine, their working principle, application and thermodynamics process involved.
2. Study the conversion of fluid energy to mechanical energy in Turbo machine with utilization factor and degree of reaction.
3. Analyze various designs of steam turbine and their working principle.
4. Study the various designs of hydraulic turbine based on the working principle.
5. Understand the various aspects in design of power absorbing machine.

Module – 1

Introduction: Definition of turbo machine, parts of turbo machines, Comparison with positive displacement machines, Classification, Dimensionless parameters and their significance, Unit and specific quantities, model studies and its numerical.

Thermodynamics of fluid flow: Application of first and second law of thermodynamics to turbo machines, efficiencies of turbo machines, Static and Stagnation states, overall isentropic efficiency, stage efficiency (their comparison) and polytropic efficiency for both compression and expansion processes. Reheat factor for expansion process. Simple Numerical on-stage efficiency and polytropic efficiency. **08 Hours**

Module - 2

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

General Analysis of Turbo machines: Radial flow compressors and pumps – general analysis, Expression for degree of reaction, **velocity** triangles, Effect of blade discharge angle on energy transfer and degree of reaction, Effect of blade discharge angle on performance, General analysis of axial flow pumps and compressors, degree of reaction, velocity triangles, Numerical Problems. **08 Hours**

Module – 3

Steam Turbines: Classification, difference between Impulse and Reaction Steam turbine, Single stage impulse turbine, condition for maximum blade efficiency, stage efficiency, Need and methods of compounding, Multi-stage impulse turbine (Analysis on two stages no derivation), Numerical Problems.

Reaction turbine – Degree of reaction, Parson's turbine, condition for maximum efficiency, reaction staging. Numerical Problems. **08 Hours**

Module - 4

Hydraulic Turbines: Classification, heads and efficiencies of hydraulic turbines.

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

Francis turbine– Principle of working, velocity triangles, design parameters, and numerical problems. **Kaplan and Propeller turbines** - Principle of working, velocity triangles, design parameters and Numerical Problems. Theory and types of Draft tubes. **08 Hours**

Module – 5

Centrifugal Pumps: Classification and parts of centrifugal pump, different heads and efficiencies of centrifugal pump, minimum speed for starting the flow, Net positive suction head, Cavitation, Need for priming, Pumps in series and parallel. Problems.

Centrifugal Compressors: Stage velocity triangles, slip factor, power input factor, Stage work, Pressure developed, stage efficiency and surging and problems. **08 Hours**

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Model studies and thermodynamics analysis of turbo machines.
CO2	Analyze the energy transfer in Turbo machine with degree of reaction and utilization factor.
CO3	Classify, analyze and understand various type of steam turbine.
CO4	Classify, analyze and understand various type of hydraulic turbine.
CO5	Recognize the concept of radial power absorbing machine and the problems involved during its operation.

CO-PO Matrix:

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	1									2	2	2
2	3	2	1									2	2	2
3	2	2	2									2	2	2
4	3	2	2									2	2	2
5	3	2	1									2	2	2

Suggested Learning Resources:

SN	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Turbo machines	M.S. Govinde gowda	M.M Publications	10th Edition 2018
2	An Introduction to energy conversion	V. Kadambi and Manohar Prasad	New Age International	Volume II
3	Turbines	S. M. Yahya	Tata-McGraw Hill Co.	4th Edition
References				
1	Principles of Turbo Machinery	D. G. Shepherd	The Macmillan Company	1964
2	Fundamentals of Turbo machinery	William W Peng	John Wiley & Sons, Inc.	2008
3	Principles of Turbo machinery	R K Turton	Chapman & Hall	2nd Edition (1995)
4	Fluid Mechanics and Thermodynamics of Turbo machinery	S L Dixon and C A Hall	Butterworth-Heinemann	6th Edition

E-Resources: NPTEL course -https://archive.nptel.ac.in/courses/112/104/112104305/

SEMESTER: V

Course Name: THEORY OF MACHINES

Course Code	**21ME52**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**2:2:0**	**SEE Marks**	**50**
Total Hours of pedagogy	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Pre-requisites: Knowledge of Basic sciences and Mathematics.

Course objectives:

1. To understand the concept of machines, mechanisms and motion transmission elements used in mechanical engineering.
2. To understand the concept of static and dynamic force analysis.
3. To understand the terminology of spur gear, gear trains and its applications.
4. To understand the undesirable effects of unbalances resulting from prescribed motion in mechanism.
5. To understand the theory of cams and to analysis the effect of governors and its application.

Module – 1

Introduction: Mechanisms and machines, Kinematic pairs-types, degree of freedom, Kinematic chains and their classification, Kinematic in versions,

Velocity and Acceleration analysis of planar mechanisms Graphical method: Velocity and Acceleration Analysis of Mechanisms Velocity and acceleration analysis of four bar mechanism, slider crank mechanism. Mechanism illustrating Corioli's component of acceleration. Angular velocity and angular acceleration of links, velocity of rubbing.

Velocity and Acceleration Analysis of Mechanisms (Analytical Method): Velocity and acceleration analysis of four bar mechanism, slider crank mechanism using complex algebra method. **08 Hours**

Module - 2

Static force analysis: Static equilibrium, analysis of four bar mechanism, slider crank mechanism.

Dynamic force analysis: D'Alembert's principle, analysis of four bar and slider crank mechanism. **08 Hours**

Module – 3

Spur Gears: Gear terminology, law of gearing, path of contact, arc of contact, contact ratio of spur gear. Interference in involute gears, methods of avoiding interference, condition and expressions for minimum number of teeth to avoid interference.

Gear Trains: Simple gear trains, compound gear trains. Epicyclic gear trains: Algebraic and tabular methods of finding velocity ratio of epicyclic gear trains, torque calculation in epicyclic gear trains. Discussions on applications of gear trains. **08 Hours**

Module – 4

Balancing of Rotating Masses: Static and Dynamic Balancing, Balancing of single rotating mass by balancing masses in same plane and in different planes. Balancing of several rotating masses by balancing masses in same plane and in different planes. Discussions on applications.

Balancing of Reciprocating Masses: Inertia Effect of crank and connecting rod, Single cylinder Engine, Balancing in multi cylinder-inline engine (primary and secondary forces). Discussions on applications. **08 Hours**

Module – 5

Governors: Types of Governors; Force Analysis of Porter and Hartnell Governors. Controlling Force, Stability, Sensitiveness, Isochronism, Effort and Power. Discussion on applications.
Cams: Classification of cams, Types of followers, Cam nomenclature, Follower motions and motion analysis, of SHM, Motion with uniform acceleration and deceleration, uniform velocity, cycloidal motion, Cam profile with offset knife edge follower, roller follower, flat faced follower.

08 Hours

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Describe mechanisms their motion and inversions of mechanisms
CO2	Examine the velocity, acceleration of links and joints of mechanisms.
CO3	Analyze the mechanisms for static and dynamic equilibrium.
CO4	Carry out the balancing of rotating and reciprocating masses
CO5	Analyze different types of governors and Cams used in real life situation.

CO-PO Matrix:

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	1	1		1									1	1
2	3	2		1									1	1
3	3	2		1									1	1
4	3	3		1									3	2
5	3	2		1									3	3

Suggested Learning Resources:

SN	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Theory of Machines	Sadhu Singh	Pearson	3th Edition
2	Dynamics of Machinery	J B K Das P L Srinivasa Murthy	Sapna Book House	6th Edition
		References		
1	Theory of Machines	Rattan S S	Tata McGraw-Hill	2014
2	Mechanisms and Machines	Michael M Stanisic	Cengage	2016
3	Theory of Machines	R S Khurmi and Gupta J K	S Chand	2015

E-Resources: https://archive.nptel.ac.in/courses/112/106/112106270/

SEMESTER: V

Course Name: PRODUCTION TECHNOLOGY - II

Course Code	**21ME53**	**CIE Marks**	**50**
Teaching Hours/Week(L:T:P:S)	**2:2:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 Hours**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Pre-requisites: Knowledge of Basic sciences and Techniques**.**

Course objectives:

1. To know the various metal operations processes in industries.
2. To calculate the values of various forces involved in the machining operations.
3. To understand and determine tool wear and tool life of different machining processes.
4. To know various processes finishing technique and protection process.
5. To know the Importance of jigs and fixtures and concept of smart manufacturing.

Module – 1

Principles of Metal cutting: Orthogonal and oblique cutting. Classification of cutting tools: single and multipoint cutting tools; tool signature for single point cutting tool. Mechanics of orthogonal cutting; chip formation, shear angle and its significance, Merchant circle diagram. Numerical problems. Cutting tool materials and applications **08 Hours**

Module - 2

Machine Tools: Lathe- Parts of lathe machine, specification, accessories of lathe machine, and various operations carried out on lathe.
Milling: Various Milling operations, classification of milling machines, Vertical & Horizontal milling, up milling & down milling. Indexing: need of indexing, simple, compound & differential indexing.
Drilling: Difference between drilling, boring & reaming, types of drilling machines, Boring-operations & machines. **08 Hours**

Module - 3

Tool wear- types of tool wear, tool wear mechanisms, tool life equations, effect of process parameters on tool Life, machinability. Machinability index, factors affecting Machinability, Cutting fluid-types and applications, surface finish, effect of machining parameters on Surface finish. Economics of machining process, choice of cutting speed and feed, tool life for minimum cost and production time. Numerical problems. **08 Hours**

Module – 4

Finishing Process: Grinding, types of grinding machines, cylindrical and centerless grinding machines, Importance of surface finishing processes, Abrasive Flow Machining, and Honing, Lapping, Polishing, abrasives, types of abrasives.
Surface Finishing and Protection: Powder Coating, Liquid Coating, Electroplating, Galvanizing, Anodizing. **08 Hours**

Module – 5

Jigs and Fixtures: Importance of jigs and fixtures; the difference between jigs and fixtures; types of jigs and fixtures; essential features of jigs and fixtures.
Smart manufacturing: Need for additive manufacturing, generic AM process, concept of stereolithography or 3D printing, rapid prototyping, the benefits of AM, basics of CNC, difference between AM and CNC machining, AM applications**.** **08 Hours**

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Acquire the basic knowledge of various metal cutting operations and methods.
CO2	Discuss different machine tools and their principle operations and parameters.
CO3	Analyze tool wear mechanisms and equations to enhance tool life and minimize machining cost.
CO4	Apply mechanism of finishing process and coating methods to protect the surface quality.
CO5	Analyze Importance of jigs and fixtures and basic concept of smart manufacturing.

CO-PO Matrix:

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2											1	1
2	2	2											1	1
3	2	2											1	1
4	2	2											1	1
5	2	2											1	1

Suggested Learning Resources:

Text Books				
Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Manufacturing Technology Vol I& II	P.N. Rao	Tata McGraw Hill Pub. Co. Ltd., New Delhi	1998
2	A textbook of Production Technology Vol I and II	Sharma, P.C	S. Chand & Company Ltd., New DelhI	1996
3	Production technology	Hindustan Machine Tools	Tata McGraw Hill Pub. Co. Ltd., New Delhi	2012
4	Production technology	O. P Kanna	Dhanpatrai publications	1999
Reference Books				
1	Manufacturing Science	Amitabh Gosh &A K Malik	East-West press	2001
2	Metal Forming: Mechanics and Metallurgy	Hosford W F and Caddell R M	Prentice Hall	1993
3	Manufacturing Engineering and Technology	Kalpakjain	Addision Wesley, Congmen Pvt. Ltd.	2000

E-Resources:

1. www.nptel.ac.in
2. https://youtu.be/6cxazvaS6SA
3. https://youtu.be/bUrp8JMRwx4
4. https://youtu.be/nUQ9rvNES7U
5. https://youtu.be/GghdbT0CyvI?list=PLVxUmFzqKAUHf1pg7NhMzD58pQVnhR8XA
6. https://youtu.be/h2pKPpLWwr8?list=PLVxUmFzqKAUHf1pg7NhMzD58pQVnhR8XA
7. https://youtu.be/2fDJ1Wk-y04?list=PLVxUmFzqKAUHf1pg7NhMzD58pQVnhR8XA
8. https://youtu.be/YCLZMx_nhsM
9. https://youtu.be/W-V7zfOVNkE

SEMESTER: V

PROFESSIONAL ELECTIVE-I

Course Name: COMPOSITE MATERIALS

Course Code	**21ME541**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**2:2:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Pre-requisites: Knowledge of Basic mathematics and sciences.

Course objectives:

1. To know the behavior of constituents in the composite materials
2. To enlighten the students in different types of reinforcement and matrices.
3. To develop the student's skills in understanding the different manufacturing methods available for composite material.
4. To understand the various characterization techniques
5. To illuminate the knowledge and analysis skills in applying basic laws in mechanics to the composite materials.

Module – 1

Introduction to composite materials: Definition and classification of composites based on matrix and reinforcement, Characteristics of composite materials, Fibrous composites, Laminate composites and particulate composites. Factors which determine the properties of composites, Benefits of composites, properties and types of reinforcements and matrices, Reinforcement-matrix interface, Introduction to Natural fibre composites, carbon fibres. **08 Hours**

Module - 2

Polymer matrix composites: Introduction, Polymer matrices, Processing methods like Lay-up and curing, open and closed mold process- hand layup techniques, laminate bag molding, production procedures for bag molding, filament winding, pultrusion, polyforming, thermo-forming, molding methods, properties of PMCs and applications, Some commercial PMCs. **08 Hours**

Module - 3

Metal matrix composites: Introduction, Metallic matrices, Classification of MMCs, need for production of MMCs, Interface reactions, processing methods like Powder metallurgy, diffusion bonding, Melt stirring, Compo/Rheo casting, Squeeze casting, Liquid melt infiltration, Spray deposition and in situ Processes, Properties of metal matrix composites, Applications, Some commercial MMCs. **08 Hours**

Module – 4

Mechanics of composite materials: Continuous fibres, Iso-stress condition, Iso-strain condition, critical volume fraction of fiber, minimum volume fraction of fiber and Rule of mixture. Numerical on Iso-stress and strain conditions, and mechanics of discontinuous fibres, stress vs strain curves for PMCs, MMCs, and CMCs. **08 Hours**

Module – 5

Nonconventional Composites: Introduction, Nano composites; Polymer clay nano composites, self-healing composites, self-reinforced composites. Bio composites, Laminates; Ceramic Laminates, Hybrid Composites. Performance/Characterization of Composites: Mechanical Properties; Tensile Properties, Compressive Properties, Flexural Properties, In-Plane Shear Properties, Fatigue Properties; Tension–Tension Fatigue, Flexural Fatigue. Impact Properties; Charpy, Izod. **08 Hours**

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Comprehend the composites, matrix and reinforcement, the types, benefits and properties of composites
CO2	Apply the concept of polymer matrix composites, their production methods and applications
CO3	Illustrate the metal matrix composites, their production methods and applications
CO4	Analyze the mechanics of composite materials; solve the numerical on modulus of rigidity.
CO5	Evaluate characteristics of nonconventional composite, hybrid composites and ceramic laminates.

CO-PO Matrix:

COs	**Program Outcomes (POs)**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	2			2									3	2
2	1			2								1	2	2
3	2			1								1	2	3
4	2			2								1	2	2
5	2			3								1	2	2

Suggested Learning Resources:

SN	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Composite Science and Engineering	K. K. Chawla	Springer Verlag	1998
2	Introduction to composite materials	Hull and Clyne	Cambridge University Press	2nd Edition, 1990
3	Composite Materials: Engineering and Science	F. L. Mathew and R. D. Rawlings	Woodhead Publishing Limited	Woodhead Publishing Limited
Reference Books				
1	Composite materials handbook	Meing Schwaitz	McGraw Hill Book Company	1984
2	Mechanics of Composite Materials	Robert M. Jones	McGraw Hill Kogakusha Ltd	1998
3	Mechanics of composites	Artar Kaw	CEC Press	2002

E-Resources:

1. https://www.youtube.com/watch?v=H1SIpk0h4-Q
2. https://www.youtube.com/watch?v=slgtMk8k4lk
3. https://www.science.org.au/curious/technology-future/composite-materials
4. https://www.spiedigitallibrary.org/conference-proceedings-of-spie/10596/1059603/Current-and-futureneeds-and-research-for-composite-materials-NDE/10.1117/12.2291921.full?SSO=1
5. https://www.youtube.com/watch?v=_m29-u37TI8

SEMESTER: V

PROFESSIONAL ELECTIVE-I

Course Name: PRODUCTION AND OPERATIONS MANAGEMENT

Course Code	**21ME543**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P:S)	**2:2:0**	**SEE Marks**	**50**
Total Hours of Teaching-Learning	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Pre-requisites: Decision-making, capacity planning, aggregate planning, forecasting, inventory management, distribution planning, materials requirements

Course objectives:

1. Use of decision-making tools such as break-even analysis, linear programming, statistical analysis, simulation, etc. demands a strong knowledge of mathematics, science and engineering fundamentals.
2. Forecasting models are basically mathematical equations. Formulating these models and solving them requires skill and a strong knowledge of mathematics, science, engineering & management fundamentals.
3. Facility location and Capacity planning can be made by the use various mathematical models. Use of these models and solving them subsequently for arriving at a decision demands skill and knowledge on mathematics, science, engineering & management fundamentals.
4. Preparation of aggregate plans and master schedule in an organization requires a strong background of mathematics, science, engineering & management fundamentals.

Module – 1

Introduction: Functions within business organizations, the operation management function, Classification of production systems, Productivity, factors affecting productivity. (No Numerical Problems)

Decision Making: The decision process, characteristics of operations decisions, use of models, decision making Environments, graphical linear programming, analysis and trade-offs. (Numerical Problems). **08 Hours**

Module - 2

Forecasting: Steps in forecasting process, approaches to forecasting, forecasts based on judgment and opinion, analysis of time series data, accuracy and control of forecasts, choosing a forecasting technique, elements of a good forecast (Numerical Problems). **08 Hours**

Module - 3

Capacity and Location Planning: Importance of capacity decisions, defining and measuring capacity, determinants of effective capacity, determining capacity requirement, developing capacity alternatives, evaluating alternatives, need for location decisions, nature of locations decisions, general procedure for making locations decisions, evaluating locations decisions, facilities layout – need for layout decisions, types of Processing. (No Numerical Problems). **08 Hours**

Module – 4

Aggregate Planning & Master Scheduling: Aggregate planning – Nature and scope of aggregate planning, strategies of aggregate planning, techniques for aggregate planning – graphical and charting techniques, mathematical techniques. The master production schedule, Master scheduling methods and process (Numerical Problems) **08 Hours**

Module – 5

Material Requirement Planning (MRP): Dependent versus independent demand, an overview of MRP – MRP inputs and outputs, MRP processing, ERP capacity requirement planning, benefits and limitations of MRP. (Numerical Problems)

Purchasing and Supply Chain Management (SCM): Introduction, Importance of purchasing and SCM, the procurement process, Concept of tenders, Approaches to SCM, Vendor development, Vendor Rating, Vendor Certification, E-Procurement & types, Make or Buy Decision. (No Numerical Problems). **08 Hours**

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Define Production and Operations Management, basic approach of new and old system of management
CO2	Describe decision process, list the characteristics of decision making and discuss forecasting technique
CO3	Discuss overview of MRP and Location planning
CO4	Develop the aggregate planning and master scheduling
CO5	Apply Importance of purchasing and SCM

CO-PO Matrix:

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	1									1	1		
2	2	1									1	1		
3	2	1									1	1		
4	2	1									1	1		
5	2	1									1	1		

Suggested Learning Resources:

SN	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Operation Management	Joseph G Monks	McGrew Hill Publication	InternationalEdition,1987
2	Production and Operation Management	Panner selvam R	PHI publications	2nd edition
3	An Introductory book on lean System	TPS Yasuhiro Modern		
References				

1	Production and Operation Management	CharyS.N.	Tata McGrew Hill	3rd edition
2	Production and Operations Management	Everett E.Adams,Ronald J.Ebert	Prentice Hall of India	4th Edition
3	Modern Production/Operations Management	Buffia	Wiely India Ltd	4th Edition

E-Resources:

1. NOC: Production and Operation Management, IIT Roorkee: https://nptel.ac.in/courses/110107141
2. Case studies in operations management: https://www.tandfonline.com/doi/full/10.1080/09537287.2011.554736?scroll=top&needAccess=true
3. OPERATIONS MANAGEMENT course by MIT Open Courseware: https://ocw.mit.edu/courses/15-760a-operations-management-spring-2002/pages/syllabus/

SEMESTER: V

PROFESSIONAL ELECTIVE-I

Course Name: FLUID POWER ENGINEERING

Course Code	**21ME544**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P:S)	**2:2:0**	**SEE Marks**	**50**
Total Hours of Teaching-Learning	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Pre-requisites: Introduction to Algebra, Geometry, and Trigonometry (Block X02); Introduction to Fluid Power (Block Y01)

Course objectives:

1. Gain knowledge of basics of hydraulic and pneumatic systems.
2. Understanding the working principles of hydraulics and pneumatics components.
3. Engineering application of hydraulic and pneumatic systems.

Module – 1

Introduction to fluid power systems: 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. Additives, effect of temperature and pressure on hydraulic fluid. Seals, sealing materials, compatibility of seal with fluids. Types of pipes, hoses, and quick acting couplings. Pressure drop in hoses/pipes. Fluid conditioning through filters, strainers; sources of contamination and contamination control; heat exchangers. **08 Hours**

Module - 2

Pumps and actuators

Pumps: Classification of pumps, pumping theory of positive displacement pumps, construction and working of Gear pumps, Vane pumps, Piston pumps, fixed and variable displacement pumps, Pump performance characteristics, pump selection factors, numericals on pumps.

Accumulators: Types, selection/ design procedure, applications of accumulators. Types of Intensifiers, Pressure switches /sensor, Temperature switches/sensor, Level sensor.

Actuators: Classification cylinder and hydraulic motors, Hydraulic cylinders, single and double acting cylinder, mounting arrangements, cushioning, special types of cylinders, numericals 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. Symbolic representation of hydraulic actuators (cylinders and motors). **08 Hours**

Module - 3

Components and Hydraulic circuit design Components: 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. Pressure control valves - types, direct operated types and pilot operated types. Flow Control Valves -compensated and non-compensated FCV, needle valve, temperature compensated, pressure compensated, pressure and temperature compensated FCV, symbolic representation.

Hydraulic Circuit Design: 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. Pilot pressure operated circuits. Hydraulic circuit examples with accumulator. **08 Hours**

Module – 4

Pneumatic power systems Pneumatic power system, advantages, limitations, applications, Choice of working medium. Characteristics of compressed air and air compressors. 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, use of memory valve, Quick exhaust valve, time delay valve, shuttle valve, twin pressure valve, symbols. **08 Hours**

Module – 5

Pneumatic control circuits: Direct and indirect actuation pneumatic cylinders, speed control of cylinders - supply air throttling and exhaust air throttling.

Signal Processing Elements: Use of Logic gates - OR & AND gates in pneumatic applications. Practical examples involving the use of logic gates.

Multi- Cylinder Application: 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).

Electro- Pneumatic Control: Principles - signal input and output, pilot assisted solenoid control of directional control valves, use of relay and contactors. Control circuitry for simple signal cylinder application. **08 Hours**

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Identify and analyse the functional requirements of a fluid power transmission system for a given application.
CO2	Visualize how a hydraulic/pneumatic circuit will work to accomplish the function.
CO3	Design an appropriate hydraulic or pneumatic circuit or combination circuit like electro-hydraulics, electro-pneumatics for a given application.
CO4	Select and size the different components of the circuit
CO5	Develop a comprehensive circuit diagram by integrating the components selected for the given application.

CO-PO Matrix:

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	1										2	2	2
2	3	3										2	2	1
3	2	2	2									2	2	2
4	2	2	2									2	2	2
5	1		1		1							2	2	2

Suggested Learning Resources:

SN	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Fluid Power with Applications	Anthony and Esposito	Pearson	2000
2	Oil Hydraulics	Majumdar S R	Tata McGraw Hill	2002
3	Hydraulics and Pneumatics	Hegde and Niranjan Murthy		2012
References				
1	Industrial Hydraulics	John Pippenger	McGraw Hill	1980
2	Fundamental of Pneumatic		FESTO	
3	Hydraulics and Pneumatics	Andrew Par	Jaico Publishing house	2005

E-Resources: https://archive.nptel.ac.in/courses/112/106/112106300/

SEMESTER: V

OPEN ELECTIVE-I

Course Name: ENGINEERING ECONOMICS

Course Code	**21ME551**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**2:2:0**	**SEE Marks**	**50**
Credits	**40**	**Exam Hours**	**03**
Total Number of Pedagogy Hours	**03**	**Total Marks**	**100**

Pre-requisites: Basic Science and Mathematics.

Course objectives:

1. Economic Decision-Making Skills: Develop a clear understanding of the role of engineering in the economy and enhance problem-solving abilities through both intuitive and analytical approaches.
2. Comparative Analysis: Master the techniques for present worth comparisons, including the rule of 72, net present worth calculations, and equivalent annual worth comparisons, enabling effective evaluation of investment options.
3. Depreciation Knowledge: Gain insights into the significance of depreciation, apply various depreciation methods, and calculate asset values, facilitating informed decisions related to asset management.
4. Effective Replacement Analysis: Acquire the skills to determine optimal asset replacement timing based on deterioration, obsolescence, and inadequacy considerations, incorporating time value of money principles for accurate analysis.
5. Accurate Cost Estimation: Understand the components of costs, apply mensuration techniques to calculate cost components, and estimate the cost of simple components, fostering proficiency in cost estimation and budgeting processes.

Module – 1

Introduction: Engineering decision–makers, engineering and economics, problem solving, intuition and analysis, tactics and strategy with an example.

Interest and Interest Factors: Interest rate, simple interest compound interest, interest formulae, time value equivalence exercises, numericals and discussion. **08 Hours**

Module - 2

Present Worth Comparison: Conditions for present worth comparisons, rule 72, and basic present worth comparisons, present worth equivalence, net present worth, assets with equal and unequal lives, comparison of assets assume to have infinite lives, exercises and problems.

Equivalent Annual Worth Comparisons: Situations for equivalent annual worth comparison, net annual worth of a single project, comparison of net annual worth's, definitions of asset life, comparison of assets with equal and unequal lives, exercises and problems. **08 Hours**

Module – 3

Depreciation: Introduction, Reasons for Depreciation, Various methods of depreciation, Numerical Problems on all the methods of Depreciation. **08 Hours**

Module - 4

Replacement Analysis: Introduction, Reasons for Replacements-Deterioration, obsolescence, inadequacy, replacement criteria problems, Replacements of assets considering and ignoring time value of money. Group Replacements. Numerical problems on the above types of Replacement Problems. **08 Hours**

Module – 5

Estimating and Costing: components of costs such as direct material cost, direct labour cost, Fixed, over–heads, factory costs, administrative–over heads, first cost, selling price, calculation of the total cost of various components, mensuration, estimation of simple components. **08 Hours**

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Recall the basic concepts of decision making, problem solving, tactics and strategy.
CO2	Define the time value of money concept, interest formulae.
CO3	Elucidate the comparison by present worth method for different lives of the asset. Compare the asset on the basis of EAW comparison.
CO4	Clarify the concepts of depreciation and replacement criteria.
CO5	Calculate the total cost of a component and explain the process for estimating simple components.

CO-PO Matrix:

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3					3			3	3			3	3
2	3	3				3			3	3	3		3	3
3	3		3			3	3		3	3		3	2	2
4	2	2		2		2			2	2			3	3
5	2				2		2	2		2			2	2

Suggested Learning Resources:

SN	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Engineering Economics	R. Panneer selvam	Pearson Education	6th Edition, 2018
2	Engineering Economics	James L. Riggs	McGraw-Hill Education,	10th Edition, 2016
3	Estimating and Costing	Harold E. Smallwood	Wiley,	8th Edition, 2018
References				
1	Engineering Economic Analysis	Donald G. Newnan	McGraw-Hill Education	12th edition 2019
2	Depreciation	James R. Miller	Prentice Hall,	10th Edition, 2019
3	Engineering Economy and Cost Analysis	Richard G. Hammack	Wiley	5th Edition, 2017

E-Resources:

1. https://highered.mheducation.com/sites/0072432349/student_view0/web_links.html
2. https://onlinecourses-archive.nptel.ac.in/noc16_me13/preview
3. https://people.utm.my/shamsul/wp-content/blogs.dir/949/files/2016/03/Engineering-Economy.pdf
4. https://www.youtube.com/watch?v=9yj6CtMUsYU
5. https://www.investopedia.com/terms/c/compoundinterest.asp
6. https://www.youtube.com/watch?v=ZSoLPCHsknA
7. https://www.youtube.com/watch?v=r0aDjTLxy5c
8. https://www.youtube.com/watch?v=r0aDjTLxy5c

Semester: V

Open Elective-I

Course Name: ENERGY AND ENVIRONMENT

Course Code	**21ME552**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**2:2:0**	**SEE Marks**	**50**
Credits	**03**	**Exam Hours**	**03**
Total Hours of Pedagogy	**40**	**Total**	**100**

Pre-requisites: Knowledge of Basic sciences**.**

Course objectives:

1. To understand the fundamentals of energy sources, energy use, and resulting environmental implications.
2. To introduce various aspects of environmental pollution and its control.
3. To understand the causes and remedies related to social issues like global warming, ozone layer depletion, climate change etc.
4. To introduce various acts related to prevention and control of pollution of water and air, forest protection act, wild life protection act.

Module – 1

Introduction to Energy: Energy and power, forms of energy, primary energy sources, energy flows, world energy production, and consumption, Key energy trends in India: Demand, Electricity, Access to modern energy schemes, Energy production and trade, Factors affecting, Energy and Sustainability.
India's energy development: Economy and demographics, Policy and institutional framework, Energy prices and affordability, Social and environmental aspects, Investment. **08 Hours**

Module - 2

Energy storage systems: Thermal energy storage methods, Energy saving, Thermal energy storage systems Energy Management: Principles of Energy Management, Energy demand estimation, Energy pricing
Energy Audit: Purpose, Methodology with respect to process Industries, Characteristic method employed in Certain Energy Intensive Industries. **08 Hours**

Module – 3

Environment: Introduction, Multidisciplinary nature of environmental studies- Definition, scope and importance, Need for public awareness.
Ecosystem: Concept, Energy flow, Structure and function of an ecosystem. Food chains, food webs and ecological pyramids, Forest ecosystem, Grassland ecosystem, Desert ecosystem and Aquatic ecosystems, Ecological succession.
08 Hours

Module – 4

Environmental Pollution: Definition, Cause, effects and control measures of - Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution and Nuclear hazards, Solid waste Management, Disaster management Role of an individual in prevention of pollution, Pollution case studies.
08 Hours

Module – 5

Social Issues and the Environment: Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies. Wasteland reclamation, Consumerism and waste products, Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation.

08Hours

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Identify and Discuss energy scenario, energy sources and their utilization.
CO2	Apply the various methods of energy storage, energy management and economic analysis.
CO3	Investigate the awareness about environment and eco system.
CO4	Discuss the environment pollution along with social issues and acts.
CO5	Deliberate the Social Issues and impact on Environment.

CO-PO Matrix:

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	1					2	2					2	1	1
2	2	2				1						2	1	1
3	1	1				1	2	2				2	1	1
4	1					2	2					2	1	1
5	1						2	2				2	1	1

Suggested Learning Resources:

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Textbook for Environmental Studies for Undergraduate Courses of all Branches of Higher Education	Erach Bharucha	University grant commission and Bharathi Vidyapeeth Institute of environment education and Research, Pune	1st Edition
2	Energy Management Audit & Conservation- for Module 2	Barun Kumar De	Vrinda Publication	2nd Edition 2010
Reference				
1	Energy Management Hand book	Turner, W. C., Doty, S. and Truner, W. C	Fairmont Press	7th Edition 2009
2	Energy Management	Murphy, W. R	Elsevier	2007

3	Energy Management Principles	Smith, C. B	Pergamum	2007
4	Environment pollution control Engineering	C S Rao	New Age International	reprint 2015, 2nd edition
5	Environmental studies	Benny Joseph	Tata McGraw Hill	2nd edition 2008

E-Resources:

1. https://www.youtube.com/watch?v=L3AEXdvtIkk&list=PLwdnzlV3ogoXUifhvYB65lLJCZ74o_fAk&index=19
2. www.iso.org/iso-14001-environmental-management.
3. www.sciencedirect.com/topics/earth-and-planetary-sciences/energy-management
4. www.india.gov.in/official-website-ministry-environment-and-forests

SEMESTER: V

Open Elective

Course Name: TOTAL QUALITY MANAGEMENT

Course Code	**21ME553**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**2:2:0**	**SEE Marks**	**50**
Credits	**03**	**Exam Hours**	**03**
Total Pedagogy	**40**	**Total**	**100**

Pre-requisites: Basic science and Mathematics

Course objectives:

1. Understand various approaches to TQM
2. Understand the characteristics of quality leader and his role.
3. Develop feedback and suggestion systems for quality management.
4. Enhance the knowledge in Tools and Techniques of quality management.

Module – 1

Principles and Practice: Definition, basic approach, gurus of TQM, TQM Framework, awareness, defining quality, historical review, obstacles, benefits of TQM.
Quality Management Systems: Introduction, benefits of ISO registration, ISO 9000 series of standards, ISO9001 requirements **08 Hours**

Module - 2

Leadership: Definition, characteristics of quality leaders, leadership concept, characteristics of effective people, ethics, the Deming philosophy, role of TQM leaders, implementation, core values, concepts and framework, strategic planning communication, decision making. **08 Hours**

Module – 3

Customer Satisfaction and Customer Involvement: Customer Satisfaction: customer and customer perception of quality, feedback, using customer complaints, service quality, translating needs into requirements, customer retention, case studies.
Employee Involvement – Motivation, employee surveys, empowerment, teams, suggestion system, recognition and reward, gain sharing, performance appraisal, unions and employee involvement, case studies. **08 Hours**

Module – 4

Continuous Process Improvement: process, the Juran trilogy, improvement strategies, types of problems, the PDCA Cycle, problem-solving methods, Kaizen, reengineering, six sigma, case studies. Statistical Process Control: Pareto diagram, process flow diagram, cause and effect diagram, check sheets, histograms, statistical fundamentals, Control charts, state of control, out of control process, control charts for variables, control charts for attributes, scatter diagrams, case studies. **08 Hours**

Module – 5

Total Productive Maintenance (TPM): Definition, Types of Maintenance, Steps in introduction of TPM in an organization, Pillars of TPM – 5S, Jishu Hozen, Quality Maintenance, Planned Maintenance. Quality by Design (QbD): Definition, Key components of QbD, Role of QbD in Pharmaceutical & other Industry, Benefits and Challenges of QbD.
Environmental Management Systems (EMS): Definition, Basic EMS, EMS under ISO 14001, Costs and Benefits of EMS. **08 Hours**

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Describe the various approaches of TQM.
CO2	Infer the customer perception of quality.
CO3	Analyze customer needs and perceptions to design feedback systems.
CO4	Apply statistical tools for continuous improvement of systems.
CO5	Apply the tools and technique for effective implementation of TQM.

CO-PO Matrix:

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2	1			1		1	3			1	2	2
2	2	1	2			1		2	2			2	3	3
3	2	3	2			1		1	3			1	2	2
4	3	3	1			1		1	3			2	2	3
5	2	2	2			1		1	2			1	2	3

Suggested Learning Resources:

SN	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Total Quality Management	Dale H. Besterfield	Pearson Education India	3th Edition
2	Total Quality Management for Engineers	M. Zairi Wood head	ISBN:185573024	3th Edition
References				
1	Managing for Quality and Performance Excellence	James R. Evans William M Lindsay	Cengage Learning	9th Edition
2	Four revolutions in management	Shoji Shiba Alan Graham David Walden Oregon	Taylor & Francis, 2001	1990
3	Organizational Excellence through TQM	H. Lal	New age Publications	2008

E-Resources: https://archive.nptel.ac.in/courses/110/104/110104080/

SEMESTER: V

Open Elective

Course Name: NON-CONVENTIONAL ENERGY SOURCES

Course Code	**21ME554**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**2:2:0**	**SEE Marks**	**50**
Credits	**03**	**Exam Hours**	**03**
Total Pedagogy	**40**	**Total**	**100**

Pre-requisites: Basic science and Mathematics, Basic knowledge of sources of Energy and its forms, Energy conversion methods.

Course objectives:

1. To introduce the concepts of solar energy, its radiation, collection, storage and application.
2. To introduce the concepts and applications of Wind energy, Biomass energy, Geothermal energy and Ocean energy as alternative energy sources.
3. To explore society's present needs and future energy demands.
4. To examine energy sources and systems, including fossil fuels and nuclear energy, and then focus on alternate, renewable energy sources such as solar, biomass (conversions), wind power, geothermal, etc.
5. To get exposed to energy conservation methods.

Module – 1

Introduction: Energy source, India's production and reserves of commercial energy sources, need for non- conventional energy sources, energy alternatives, solar, thermal, photovoltaic. Water power, wind biomass, ocean temperature difference, tidal and waves, geothermal, tar sands and oil shale, nuclear (Brief descriptions); advantages and disadvantages, comparison (Qualitative and Quantitative).

04 Hours

Module - 2

Solar Radiation: Extra-Terrestrial radiation, spectral distribution of extra-terrestrial radiation, solar constant, solar radiation at the earth's surface, beam, diffuse and global radiation, solar radiation data.

Measurement of Solar Radiation: Pyrometer, shading ring pyrheliometer, sunshine recorder, schematic diagrams and principle of working.

Solar Radiation Geometry: Flux on a plane surface, latitude, declination angle, surface azimuth angle, hour angle, zenith angle, solar altitude angle expression for the angle between the incident beam and the normal to a plane surface (No derivation) local apparent time. Apparent motion of sum, day length, numerical examples.

Radiation Flux on a Tilted Surface: Beam, diffuse and reflected radiation, expression for flux on a tilted surface (no derivations) numerical example.

Solar Thermal Conversion: Collection and storage, thermal collection devices, liquid flat plate collectors, solar air heaters concentrating collectors (cylindrical, parabolic, paraboloid) (Quantitative analysis); sensible heat storage, latent heat storage, application of solar energy water heating. Space heating and cooling, active and passive systems, power generation refrigeration distillation (qualitative analysis).

12 Hours

Module – 3

Performance Analysis of Liquid Flat Plate Collectors: General description, collector geometry, selective surface (qualitative discussion) basic energy-balance equation, stagnation temperature, transmissivity of the cover system, transmissivity — absorptivity product, numerical examples. The overall loss coefficient, correlation for the top loss coefficient, bottom and side loss coefficient, problems (all correlations to be provided).

Temperature distribution between the collector tubes, collector heat removal factor, collector efficiency factor and collector flow factor, mean plate temperature, instantaneous efficiency (all expressions to be provided). Effect of various parameters on the collector performance; collector orientation, selective surface, fluid inlet temperature, number covers, dust.

Photovoltaic Conversion: Description, principle of working and characteristics, application.

08 Hours

Module – 4

Wind Energy: Properties of wind, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power, wind machines; Types of wind machines and their characteristics, horizontal and vertical axis wind mills, elementary design principles; coefficient of performance of a wind mill rotor, aerodynamic considerations of wind mill design, numerical examples.

Tidal Power: Tides and waves as energy suppliers and their mechanics; fundamental characteristics of tidal power, harnessing tidal energy, limitations. Ocean Thermal Energy Conversion: Principle of working, Rankin cycle, OTEC power stations in the world, problems associated with OTEC.

08 Hours

Module – 5

Geothermal Energy Conversion: Principle of working, types of geothermal station with schematic diagram, geothermal plants in the world, problems associated with geothermal conversion, scope of geothermal energy.

Energy from BioMass: Photosynthesis, photosynthetic oxygen production, energy plantation, bio gas production from organic wastes by anaerobic fermentation, description of bio-gas plants, transportation of bio-gas, problems involved with bio-gas production, application of bio-gas, application of bio-gas in engines, advantages.

Hydrogen Energy: Properties of Hydrogen with respected to its utilization as a renewable form of energy, sources of hydrogen, production of hydrogen, Storage, transportation, and risks, electrolysis of water, thermal decomposition of water, thermo chemical production bio-chemical production.

08 Hours

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Describe the environmental aspects of non-conventional energy resources and measure solar radiation.
CO2	Analyze Solar Radiation on tilted surface and solar thermal devices
CO3	Apprehend Performance of Liquid Flat Plate Collectors using energy-balance equation
CO4	Compare the need of Wind Energy and tidal energy resources, classification
CO5	Describe geothermal, bio energy and hydrogen energy working principles.

CO-PO Matrix:

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	1						2					2	1	1
2	2	2				1						2	1	1
3	2	2				1						2	1	1
4	1					1	1					2	1	1
5	1					1	1					2	1	1

Suggested Learning Resources:

SN	Title of the Book	Name of the Author/s	Name of the Publisher	Edition & Year
Textbooks				
1	Non-Convention Energy Resources	B H Khan	McGraw Hill Education (India) Pvt. Ltd.	3' d Edition
2	Solar energy	Subhas P Sukhatme	Tata McGraw Hill	2nd Edition, 1996.
3	Non-Conventional Energy Sources	G.D Rai	Khanna Publishers	2003
Reference Books				
1	Renewable Energy Sources and Conversion Technology	N. K. BansaI, Manfred KIeeman & MechaeI MeIiss	Tata McGraw Hill.	2004
2	Conventional Energy Systems	K M, Non	Wheeler Publishing Co. Ltd., New Delhi	2003

E-Resources:

1. https://archive.nptel.ac.in/courses/121/106/121106014/
2. www.pveducation.org
3. https://mnre.gov.in/
4. https://www.renewableenergyworld.com
5. https://www.iea.org
6. https://www.journals.elsevier.com/renewable-energy

SEMESTER: V

Course Name: THERMAL ENGINEERING LAB

Course Code	**21MEL56**	**CIE Marks**	**50**
Teaching Hour/Week(L:T:P)	**0:0:2**	**SEE Marks**	**50**
Credits	**01**	**Exam Hours**	**03**
Total Number of Pedagogy Hours	**20**	**Total Marks**	**100**

Pre-requisite: Basic Science and Mathematics.

Course objectives:

1. To understand the concepts of testing of I. C. Engines and methods to estimate Indicated, Brake and Frictional Power and efficiencies.
2. To understand theory and performance Calculation of Reciprocating compressor and positive displacement pumps.
3. To understand the concepts related to Refrigeration, refrigeration cycles and Air conditioning and get conversant with Psychrometric Charts, Psychrometric processes, human comfort conditions.
4. Understand typical construction of a Turbo machine, their working principle, application and conversion of fluid energy to mechanical energy in Turbo machine with utilization factor and degree of reaction.
5. Understand the working principle of hydraulic turbines and steam turbine

PART-A

1. Determination of Flash point and Fire point of lubricating oil using Abel Pensky and Marten's
2. Determination of Viscosity of a lubricating oil using Redwoods and Saybolt viscometer
3. Performance Tests on I.C. Engines, Calculations of IP, BP, Thermal efficiency, Volumetric efficiency, Mechanical efficiency, SFC, FP, heat balance sheet for:
   a. Four stroke single cylinder Diesel Engine
   b. Multi Cylinder Petrol Engine,
   c. Morse Test on Multi cylinder Petrol Engine

PART-B

1. Performance on hydraulic Turbines
   a. Pelton wheel Turbine
   b. Francis Turbine
   c. Kaplan Turbines
2. Performance hydraulic Pumps
   a. Single stage / Multi stage centrifugal pumps
   b. Reciprocating pump.
3. Performance test on a two stage Reciprocating Air Compressor.

COURSEOUTCOMES:

At the end of the course, the student will be able to:

CO1	Perform experiments to determine the properties of fuels and oils.
CO2	Test basic performance parameters of I.C. Engine and implement the knowledge in industry.
CO3	Conduct experiments on hydraulic turbines and pumps to draw characteristics.
CO4	Test basic performance parameters of hydraulic turbines and pumps and execute the knowledge in real life situations.
CO5	Conduct experiment on Air Compressor and finds the efficiency

CO-PO Matrix:

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2		2		2	1		2			1	2	1
2	3	3		2		2	1					2	2	1
3	2	3		2		2						2	2	1
4	2	3		2		2						2	2	1
5	2	2		2		1						2	2	1

SEMESTER: V

Course Name: MACHINESHOP PRCATICE LAB

Course Code	**21MEL57**	**CIE Marks**	**50**
Teaching Hour/Week(L:T:P)	**0:0:2**	**SEE Marks**	**50**
Credits	**01**	**Exam Hours**	**03**
Total Number of Pedagogy Hours	**20**	**Total Marks**	**100**

Pre-requisites: Basic science and Mathematics

Course objectives:

1. To guide students to use fitting tools to perform fitting operations.
2. To provide an insight to different machine tools, accessories and attachments.
3. To train students into fitting and machining operations to enrich their practical skills.
4. To inculcate team qualities and expose students to shop floor activities.
5. To educate students about ethical, environmental and safety standards.

PART-A
Preparation of three models on lathe involving Plain turning, Taper turning, Step turning thread cutting, Facing, Knurling, Drilling, Boring, Internal Thread cutting and Eccentric turning.
PART-B
Cutting of V Groove/dovetail /Rectangular groove using a shaper and Cutting of Gear Teeth using Milling Machine
PART-C
For demonstration Demonstration of motion of cutting parameters of single point cutting tool using bench grinder /tool & cutter grinder. Demonstration of surface milling / slot milling.

COURSEOUTCOMES:

At the end of the course, the student will be able to:

CO1	Perform turning, facing, knurling, thread cutting, tapering, eccentric turning and allied operations, keyways / slots, grooves etc using shaper.
CO2	Make keyways / slots, grooves and allied operations using shaper.
CO3	Accomplish gear tooth cutting using milling machine and demonstrate formation of cutting parameters.
CO4	Demonstrate precautions and safety norms followed in Machine Shop.
CO5	Exhibit personal skills towards working in a team.

CO-PO Matrix:

COs	**Program Outcomes (POs)**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	2	1	1								1		1	1
2	2	1	1								1		1	1
3	2	1	1								1		1	1
4	2	1	1								1		1	1
5	2	1	1								1		1	1

SEMESTER: V

ABILITY ENHANCEMENT COURSE

Name of the course: 3D Printing Laboratory

Course Code	**21ME581**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**0:0:2**	**SEE Marks**	**50**
Credits	**01**	**Exam Hours**	**03**
Total Number of Pedagogy Hours	**20**	**Total Marks**	**100**

Prerequisites: Basic science and Mathematics.

Course objectives:

1. To know the principle methods, areas of usage, possibilities and limitations of the Additive Manufacturing technologies.
2. To be familiar with the design software are used in Additive Manufacturing.
3. To know the principles of conversion 3D model to STL file
4. To know usage of 3D Printing slicing software, selection, possibilities parameters and limitations for Direct Digital Manufacturing.
5. To get exposed to print the model in 3D machine and post processing.

PART-A

1. Introduction to 3D Printing Technology
2. Introduction to Design Software (CAD, Solid Works etc.)
3. Creating 3D Model using Design Software
4. Introduction to Prusa Software
5. Introduction to Ultimaker Cura Software
6. Preparation of 3D Model in Prusa Software
7. Exercises

PART-B

1. Introduction to Engineering Components
2. Design Exercises on Engineering Components
3. Practice on Pursa Software
4. Practice on Ultimaker Cura Software
5. Hands on Practice on 3D printer
6. Exercises - Piston and cylinder arrangement, connecting rod, gears etc.

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Create basic geometrical models using CAD software package
CO2	Prepare a model using the Tinker CAD features and upload the STL file
CO3	Create a model by converting image in to 3D and upload the STL file
CO4	Analyze the 3D Printing quality parameters by controlling software's
CO5	Develop 3DP Models for industrial applications

CO-PO Matrix:

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	1	1	3		3		1					1	2	3
2	1	1	3		3		1					1	2	3
3	1	1	3		3		1					1	2	3
4	1	1	3		3		1					1	2	3
5	1	1	3		3		1					1	2	3

SEMESTER: VI

Course Name: **MANAGEMENT AND ENTREPRENEURSHIP**

Course Code	**21ME61**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**2:2:0**	**SEE Marks**	**50**
Credits	**03**	**Exam Hours**	**03**
Total Number of Pedagogy Hours	**40**	**Total Marks**	**100**

Pre-requisites: Business Knowledge, Technology and Programming Skills.

Course objectives:

1. Foundational Management Knowledge: Develop a comprehensive understanding of management concepts, including its nature, scope, functional areas, and the evolution of management thought.
2. Effective Organizational Skills: Acquire knowledge about organizing principles, staffing processes, directing techniques, and controlling methods, essential for efficient and well-structured operations.
3. Entrepreneurial Insight: Gain insights into entrepreneurship, including its evolution, functions, stages, and the critical role entrepreneurs play in economic development.
4. Small Scale Industries Proficiency: Understand the characteristics, significance, and objectives of small-scale industries, as well as the steps to initiate an SSI and the impact of changing economic policies.
5. Institutional Support and Project Preparedness: Comprehend the various support mechanisms for small scale industries, grasp the essentials of project reports, and learn to evaluate business opportunities through feasibility studies.

Module – 1

Management: Introduction - Meaning - nature and characteristics of Management, Scope and Functional areas of management - Management as a science, art of profession - Management & Administration - Roles of Management, Levels of Management, and Development of Management Thought -early management approaches - Modem management approaches.

Planning: Nature, importance and purpose of planning process Objectives - Types of plans (Meaning Only) - Decision making Importance of planning - steps in planning & planning premises - Hierarchy of plans. **08 Hours**

Module - 2

Organizing and Staffing: Nature and purpose of organization Principles of organization - Types of organization - Departmentation Committees Centralization Vs Decentralization of authority and responsibility Nature and importance of staffing Process of Selection & Recruitment.

Directing & Controlling: Meaning and nature of directing Leadership styles, Motivation Theories, Communication - Meaning and importance - coordination, meaning and importance and Techniques of Co Ordination. Meaning and steps in controlling. **08 Hours**

Module – 3

Entrepreneur: Meaning of Entrepreneur; Evolution of the Concept; Functions of an Entrepreneur, Types of Entrepreneur, Entrepreneur - an emerging. Class. Concept of Entrepreneurship - Evolution of Entrepreneurship, Development of Entrepreneurship; Stages in entrepreneurial process; Role of

entrepreneurs in Economic Development; Entrepreneurship in India; Entrepreneurship – its Barriers. **08 Hours**

Module - 4

Small Scale Industries: Definition; Characteristics; Need and rationale; Objectives; Scope; role of SSI in Economic Development. Advantages of SSI Steps to start and SSI - Government policy towards SSI; Different Policies of SSI; Government Support for SSI during 5-year plans. Impact of Liberalization, Privatization, Globalization on SSI Effect of WTO/GA TT Supporting Agencies of Government for SSI, Meaning, Nature of support; Objectives; Functions; Types of Help; Ancillary Industry and Tiny Industry. **08 Hours**

Module – 5

Institutional Support: Different Schemes; TECKSOK; KIADB; KSSIDC; KSIMC; DIC Single Window Agency; SISI; NSIC; SIDBI; KSFC.

Preparation of Project: Meaning of Project; Project Identification; Project Selection; Project Report; Identification of critical path, Need and Significance of Report; Contents; Formulation; Guidelines by Planning Commission for Project report;

Network Analysis; Errors of Project Report; Project Appraisal. Identification of business opportunities: Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study & Social Feasibility Study. **08 Hours**

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Describe the nature, scope, and functions of management.
CO2	Apply the principles of planning, organizing, staffing, directing, and controlling in a management context
CO3	Identify and analyse the different types of entrepreneurs and their roles in economic development.
CO4	Evaluate the different government policies and support schemes for small-scale industries
CO5	Develop a project report that identifies, selects, and evaluates a business opportunity

CO-PO Matrix:

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3					3			3	3			2	2
2		3				3			3	3	3		2	2
3			3			3	3		3	3		3	1	1
4	2	2		2		2			2	2			2	2
5					2		2	2		2			1	1

Suggested Learning Resources:

SN	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Principles of Management	C. Tripathi, P.N Reddy	Tata McGraw Hill	7th Edition, 2022
2	Dynamics of Entrepreneurial Development & Management	Vasant Desai	Publishing House.	4th Edition
3	Entrepreneurship Development	Poornima. M. Charantimath	Pearson	1st Edition 2006
4	Management Fundamentals-Concepts, Application, Skill	Robers Lusie	Thomson	8th Edition
5	Entrepreneurship Development	S. S. Khanka	Chand & Co	2011
6	Management, Stephen Robbins	Pearson Education	Pearson Education/PHI	17th Edition 2003
References				
1	Fundamentals of Management	DeCenzo, Agarwal, Bhattacharya and Robbins	Pearson Education,	14th Edition, 2022
2	The Effective Executive	Peter Drucker	Harper Business	6th Edition, 2006
3	The E-Myth Revisited	Michael E. Gerber	Harper Business	4th Edition, 2014

E-Resources:

1. https://www.msde.gov.in/en/related-links
2. https://openstax.org/books/principles-management/pages/7-1-entrepreneurship
3. https://www.startupindia.gov.in/content/sih/en/reources/l-d-listing.html
4. www.nptel.ac.in
5. https://www.smartzworld.com/notes/management-and-enterpreneurship-notes-me-vtu/
6. https://www.maggubhai.com/management-process-organising-and-staffing/
7. https://tutorstips.com/difference-between-directing-and-controlling/

SEMESTER: VI

Course Name: MACHINE DESIGN

Course Code	**21ME62**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**2:2:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Pre-requisites: Knowledge of mathematics, Strength of Materials and basic sciences.

Course objectives:

The student will be able:

1. To understand the various steps involved in the Design Process and also explain the principle involved in design of machine elements, subjected to different kinds of forces, from the considerations of strength, rigidity.
2. To solve design elements like Keys, joints, and springs.
3. To develop the capability to design riveted & Welded Joints, and Powder screws.
4. To design and interpret design of clutches.
5. To select transmission elements like gears and bearings from the manufacturer's catalogue.

Module – 1

Introduction: Engineering materials and their properties and manufacturing processes; use of codes and standards, selection of preferred sizes. Review of axial, bending, shear and torsion loading on machine components, combined loading, two- and three-dimensional stresses, principal stresses, stress tensors, Mohr's circles.

Design for Static and Impact Strength: Factor of safety and service factor Theories of failure, Stress concentration. Determination of Stress concentration factor. Impact Strength**:** Introduction, Impact stresses due to axial, bending and torsional loads.

Design for Fatigue Strength: Introduction- S-N Diagram, Mechanism of fatigue failure Low cycle fatigue, High cycle fatigue, Endurance limit, Endurance limit modifying factors. Goodman's and Soderberg's relationship; Stresses due to combined loading. **08 Hours**

Module - 2

Design of Joints, Keys and Couplings: Joints: Cotter and Knuckle joints. Keys & Couplings: Design of square and rectangular sunk keys. Flange coupling, Bush and Pin type coupling

Springs: Types of springs, spring materials, stresses in helical compression- circular and non-circular cross-section. Belleville springs. Leaf Springs: Stresses in leaf springs, equalized stresses, and nipping of leaf springs. **08 Hours**

Module – 3

Riveted & Welded joints: Rivet types, rivet materials, failures of riveted joints, Joint Efficiency, Boiler Joints, Lozenge Joints, Riveted Brackets, eccentrically loaded joints.

Welded joints: Types of welded joints, Strength of butt and fillet welds, eccentrically loaded welded joints.

Power Screws: Types of power screws, stresses in power screws efficiency and self-locking, design of power screw. **08 Hours**

Module – 4

Design of Clutches: Necessity of a clutch in an automobile, types of clutch, friction materials and its properties. Design of single plate, multi-plate and cone clutches based on uniform pressure and uniform wear theories.

Spur & Helical Gears: Definitions, stresses in gear tooth: Lewis equation and form factor, design for strength, dynamic load and wear.

Helical Gears: Definitions, transverse and normal module, formative number of teeth, design based on strength, dynamic load and wear. **08 Hours**

Module – 5

Bevel & Worm Gears: Definitions, formative number of teeth, design based on strength, dynamic load and wear. **Worm Gears**: Definitions, types of worm and worm gears, and materials for worm and worm wheel. Design based on strength, dynamic, wear loads and efficiency of worm gear drives. Reduction, high speed gear box

Lubrication & Journal Bearings: Lubricants and their properties, bearing materials and properties, bearing modulus, coefficient of friction, minimum oil film thickness, heat generated, and heat dissipated. Numerical examples on hydrodynamic journal bearing design.

08 Hours

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Describe the mechanical design procedure, choose materials, apply codes, standards in design process and analyze machine components under static, dynamic loads and fatigue strength.
CO2	Design machine components like joints, couplings and springs.
CO3	Analyze & design the riveted joints, welded joints and power screws.
CO4	Design of Clutches, spur and helical gears.
CO5	Apply the standard procedure for designing Bevel and Worm gears. Design concepts of hydrodynamic bearings for different applications.

CO-PO Matrix:

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	2			1						1	1	1
2	3	2	2	1		1						2	2	2
3	3	3	2	2		1						2	2	2
4	3	3	2	2		1						2	2	2
5	3	3	2	1		2						2	2	2

Suggested Learning Resources:

Data Handbooks (allowed for reference during examinations also):

SN	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Design Data Hand Book	K Mahadevan and K. Balaveera Reddy, 4th Ed.	CBS Publications	2013
2	Machine Design Data book	K. Lingaigh, 2nd edition	McGraw Hill Education,	2010

SN	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				

1	Design of Machine Elements-1	K Raghavendra, 1st edition	CBS Publishers & Distributors Pvt. Ltd., Delhi	2017
2	Design of Machine Elements-2	K Raghavendra, 2nd edition	CBS Publishers & Distributors Pvt. Ltd., Delhi	2022
3	Design of Machine Elements	V. B. Bhandari, 4th edition	Tata Mcgraw Hill 2016.	2016
4	Fundamentals of Machine Component Design:	Robert C. Juvinall and Kurt M Marshek,	Wiley India Pvt. Ltd., New Delhi, 3rd edition	2007
Reference Books				
1	Machine design	Hall, Holowenko, Laughlin (Schaum's Outline Series adapted by S.K.Somani Special Indian Edition	Tata McGraw Hill Publishing Company Ltd	2008
2	Machine Design- An integrated approach	Robert L. Norton	Pearson Education	Latest edition
3	Design of Machine Elements	M F Spotts, T E Shoup, L E Hornberger, S R Jayaram and C. V. Venatesh,	Pearson Education,	2006

e-Resources:

1. https://archive.nptel.ac.in/courses/112/105/112105125/
2. https://archive.nptel.ac.in/courses/112/106/112106137/

SEMESTER: VI

Course Name: HEAT TRANSFER

Course Code	**21ME63**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**2:2:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Pre-requisites: Knowledge of Basic sciences and mathematics.

Course objectives:

1. Study the modes of heat transfer.
2. Learn how to formulate and solve 1-D steady and unsteady heat conduction problems.
3. Apply empirical correlations for fully-developed laminar, turbulent internal flows and external boundary layer convective flow problems.
4. Study the basic principles of heat exchanger analysis and thermal design.
5. Understand the principles of boiling and condensation including radiation heat transfer related engineering problems.

Module – 1

Introductory concepts and definitions: Modes of heat transfer: Basic laws governing conduction, convection, and radiation heat transfer; Types of boundary conditions. General three-dimensional Heat Conduction Equation: Derivation of the equation in Cartesian, coordinate only. Discussion of three-dimensional Heat Conduction Equation in Polar and Spherical Co-ordinate Systems.

Steady-state one-dimensional heat conduction problems in Cartesian System: Steady-state one-dimensional heat conduction problems (i) without heat generation and (ii) constant thermal conductivity - in Cartesian system with various possible boundary conditions. Brief Introduction to variable thermal conductivity and heat generation [No numerical on variable thermal conductivity and heat generation] Thermal Resistances in Series and in Parallel. Critical Thickness of Insulation in cylinder and spheres Concept. Derivation. **8 Hours**

Module - 2

Extended Surfaces or Fins: Classification, Straight Rectangular and Circular Fins, Temperature Distribution and Heat Transfer Calculations, Fin Efficiency and Effectiveness, Applications

Transient [Unsteady-state] heat conduction: Definition, Different cases - Negligible internal thermal resistance, negligible surface resistance, comparable internal thermal and surface resistance, Lumped body, Infinite Body and Semi-infinite Body, Numerical Problems, Heisler and Grober charts. **8 Hours**

Module – 3

Numerical Analysis of Heat Conduction: Introduction, one-dimensional steady conduction and one-dimensional unsteady conduction, boundary conditions.

Thermal Radiation: Fundamental principles - Gray, White, Opaque, Transparent and Black bodies, Spectral emissive power, Wien's displacement law, Planck's laws, Hemispherical Emissive Power, Stefan-Boltzmann law for the total emissive power of a black body, Emissivity and Kirchhoff's Laws, View factor, Net radiation exchange between parallel plates, concentric cylinders, and concentric spheres, Radiation Shield. **8 Hours**

Module – 4

Forced Convection: Boundary Layer Theory, Velocity and Thermal Boundary Layers, Prandtl number, Turbulent flow, Various empirical solutions, Forced convection flow over cylinders and spheres, Internal flows –laminar and turbulent flow solutions.
Free convection: Laminar and Turbulent flows, Vertical Plates, Vertical Tubes and Horizontal Tubes, Empirical solutions. **8 Hours**

Module – 5

Heat Exchangers: Definition, Classification, applications, LMTD method, Effectiveness - NTU method, Analytical Methods, Fouling Factors, Chart Solution Procedures for solving Heat Exchanger problems: Correction Factor Charts and Effectiveness-NTU Charts.
Boiling& Condensation: pool boiling, Bubble Growth Mechanisms, Nucleate Pool Boiling, Critical Heat Flux in Nucleate Pool Boiling, Pool Film Boiling, Critical Heat Flux, Heat Transfer beyond the Critical Point, film wise and dropwise Condensation. **8 Hours**

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Identify the modes of heat transfer and apply the basic laws to formulate engineering systems.
CO2	Apply the basic laws of heat transfer to extended surface, composite material and unsteady state heat transfer problems.
CO3	Analyze heat conduction through numerical methods and apply the fundamental principle to solve radiation heat transfer problems.
CO4	Analyze heat transfer due to free and forced convective heat transfer.
CO5	Formulate the heat transfer process in heat exchangers and their practical applications, Boiling and condensation

CO-PO Matrix:

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2										2	2	2
2	3	2	1									2	2	2
3	3	2	1									2	2	2
4	3	2	1									2	2	2
5	3	2	2									2	2	2

Suggested Learning Resources:

SN	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Principals of heat transfer	Frank Kreith, Raj M. Manglik, Mark S. Bohn	Tata McGraw Hill Publications	2017
2	Heat transfer, a practical approach	Yunus A. Cengel	Tata Mc Graw Hill	5th edition
3	Heat Transfer	R K Rajput	S Chand	2019
Reference Books				

1	Heat Transfer a Basic Approach	M. NecatiOzisik	McGraw Hill, New York	2005
2	Heat Transfer	Holman, J. P.	Tata McGraw Hill, New York	9th edition 2008

E-Resources: NPTEL course- https://onlinecourses.nptel.ac.in/noc20_ch21/preview

SEMESTER: VI

PROFESSIONAL ELECTIVE

Course Name: MECHATRONICS

Course Code	**21ME643**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**2:2:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Pre-requisites: Knowledge of Basic mathematics and sciences**.**

Course objectives:

1. To understand the evolution and development of Mechatronics as a discipline.
2. To understand the applications of microprocessors & microcontroller in various systems and to know the functions of each element.
3. To demonstrate the integration philosophy in view of Mechatronics technology and to work efficiently in multidisciplinary teams.
4. To substantiate the need for interdisciplinary study in technology education.
5. To expose the students to adoptive CNC modern Machine Tools and Gain knowledge of basics of Mechatronics system design.

Module – 1

Introduction: Scope and elements of mechatronics, mechatronics design process, measurement system, requirements and types of control systems, feedback principle, Basic elements of feedback control systems, Classification of control system. Examples of Mechatronics Systems such as Automatic Car Park system, Engine management system, Antilock braking system (ABS) control, Automatic washing machine.

Transducers and sensors: Definition and classification of transducers and sensors, Difference between transducer and sensor, Principle of working and applications of light sensors, proximity switches and Hall Effect sensors. **08 Hours**

Module - 2

Microprocessor & Microcontrollers: Introduction, Microprocessor systems, Basic elements of control systems, Microcontrollers, Difference between Microprocessor and Microcontrollers. **Microprocessor Architecture**: Microprocessor architecture and terminology-CPU, memory and address, I/O and Peripheral devices, ALU, Instruction and Program, Assembler, Data Registers, Program Counter, Flags, Fetch cycle, write cycle, state, bus interrupts. Intel's 8085A Microprocessor. **08 Hours**

Module – 3

Introduction to Electrical Circuits

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

Integration: Introduction & background, Advanced actuators, Pneumatic actuators, Industrial Robot, different parts of a Robot-Controller, Drive, Arm, End Effectors, Sensor & Functional requirements of robot. **08 Hours**

Module – 4

Signal Conditioning: Introduction – Hardware – Digital I/O, Analog to digital conversions, resolution, Filtering Noise using passive components – Registers, capacitors, amplifying signals using OP amps. Digital Signal Processing – Digital to Analog conversion, Low pass, high pass, notch filtering. Data

acquisition systems (DAQS), data loggers, Supervisory control and data acquisition (SCADA), Communication methods.

Electro Mechanical Drives: Relays and Solenoids – Stepper Motors – DC brushed motors – DC brushless motors – DC servo motors – 4-quadrant servo drives, PWM's – Pulse Width Modulation. **08 Hours**

Module – 5

Mechatronics in Computer Numerical Control (CNC) machines: Design of modern CNC machines - Machine Elements: Different types of guide ways, Linear Motion guide ways. Bearings: anti-friction bearings, hydrostatic bearing and hydrodynamic bearing. Re-circulating ball screws. Typical elements of open and closed loop control systems. Adaptive controllers for machine tools. **Mechatronics Design process**: Stages of design process – Traditional and Mechatronics design concepts –Case studies of Mechatronics systems – Pick and place Robot – Automatic car park barrier**.** **08 Hours**

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Identify key elements of Mechatronics system and its representation in block diagram.
CO2	Comprehend the concept of between Microprocessor and Microcontrollers.
CO3	Develop a PLC ladder programming and implementation of real-life system
CO4	Assess various control systems used in automation.
CO5	Apply the principles of Mechatronics design to product design & Function effectively as members of multidisciplinary teams.

CO-PO Matrix:

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2			1								1	1
2	3	2			2								2	2
3	2	2			2								1	2
4	2	2			1								2	1
5	2	2			2								2	2

Suggested Learning Resources:

SN	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
		Textbooks		
1	Mechatronics-Principles Concepts and Applications	Mechatronics-Principles Concepts and Applications	Tata McGraw Hill Publications	2003
2	Mechatronics–Electronic Control Systems in Mechanical and Electrical Engineering	W.Bolton	Pearson Education 1stEdition	2005
		Reference Books		
1	Mechatronics	HMT Ltd	Tata Mc Graw Hill 1st Edition	2000

2	Mechatronics: Integrated Mechanical Electronic	K.P. Ramachandran, G.K. Vijayaraghavan, M.S. Balasundaram	Tata McGraw Hill Publications	2003
3	Mechatronics System Design	Devdas Shetty, Richard A. kolk	Cengage publishers. Second edition.	

E-Resources: https://archive.nptel.ac.in/courses/112/107/112107298/

SEMESTER: VI

PROFESSIONAL ELECTIVE

Course Name: NON-TRADITIONAL MACHINING

Course Code	**21ME641**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P:S)	**2:0:0**	**SEE Marks**	**50**
Total Hours of **Teaching-Learning**	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Pre-requisites: Knowledge of Basic mathematics and sciences**.**

Course objectives:

1. To develop the student's ability to learn comparison between conventional and non-conventional machining.
2. To make students to learn type of abrasive, size of abrasive grain, velocity of the abrasive jet and process characteristics
3. To understand the characteristics of Electro chemical and Chemical machining processes
4. To understand the processing methods Thermal Metal Removal Processes
5. To learn mechanism of electron beam machining and Laser and Beam Machining

Module – 1

Introduction:
Introduction to Non-traditional machining, Need for Non-traditional machining process, Comparison between traditional and non-traditional machining, general classification Non-traditional machining processes, classification based on nature of energy employed in machining, selection of non-traditional machining processes, Specific advantages, limitations and applications of non-traditional machining processes.

Mechanical Processes - Ultrasonic Machining:
Introduction, definition, equipment, principle of material removal, process description, elements of process, tool feed mechanism, effect of process parameters, process capability, applications, advantages and limitations. **08 Hours**

Module - 2

Abrasive Jet Machining:
Introduction, principle, equipment, variables in AJM: carrier Gas, type of abrasive, size of abrasive grain, velocity of the abrasive jet, mean number of abrasive particles per unit volume of the carrier gas, work material, standoff distance (SOD), nozzle design, shape of cut, process characteristics - material removal rate, nozzle wear, applications, advantages and disadvantages

Water jet machining (WJM) Equipment and Process, Operations, Applications, Advantages and Limitations of WJM**.** **08 Hours**

Module - 3

ELECTROCHEMICAL MACHINING (ECM): Introduction, Principle of electro chemical machining, ECM equipment, elements of ECM operation, Chemistry of ECM. ECM Process characteristics: Material removal rate, accuracy, surface finish. Process parameters: Current density, Tool feed rate, Gap between tool & work piece, velocity of electrolyte flow, type of electrolyte, its concentration temperature, and choice of electrolytes. ECM Tooling: ECM tooling technique & example, Tool & insulation materials. Applications ECM: Electrochemical grinding and electrochemical honing process. Advantages, disadvantages and application of ECG, ECH.

CHEMICAL MACHINING (CHM): Elements of the process, Resists (maskants), Etchants. Types of chemical machining process-chemical blanking process, chemical milling process. Process

characteristics of CHM: material removal rate, accuracy, surface finish, advantages, limitations and applications of chemical machining process. **08 Hours**

Module – 4

ELECTRICAL DISCHARGE MACHINING (EDM): Introduction, mechanism of metal removal, EDM equipment: spark erosion generator (relaxation type), dielectric medium-its functions & desirable properties, electrode feed control system. Flushing types; pressure flushing, suction flushing, side flushing, pulsed flushing. EDM process parameters: Spark frequency, current & spark gap, surface finish, Heat Affected Zone. Advantages, limitations & applications of EDM, Electrical discharge grinding, Traveling wire EDM.

PLASMA ARC MACHINING (PAM): Introduction, Thermal and non-thermal generation of plasma, equipment mechanism of metal removal, Plasma torch, process parameters, process characteristics. Safety precautions, applications, advantages and limitations. **08 Hours**

Module – 5

LASER BEAM MACHINING (LBM): Introduction, generation of LASER, Equipment and mechanism of metal removal, LBM parameters and characteristics, Applications, Advantages & limitations.

ELECTRON BEAM MACHINING (EBM): Introduction, Principle, equipment and mechanism of metal removal, applications, advantages and limitations. **08 Hours**

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Classify non-traditional machining and conventional machining processes along with the concept ultrasonic machining process.
CO2	Apply the concept of AJM and WJM process, their machining methods and applications.
CO3	Analyse various process parameters affecting the material removal rate for an ECM and CHM process.
CO4	Illustrate the mechanics of EDM and PAM; process parameters, characteristics and their applications.
CO5	Describe the concept LASER generation, equipment and mechanism in LBM and EBM process.

CO-PO Matrix:

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2			1		2		2				2	2
2	3	1			1		2		2				2	3
3	2	1			1		2		2				3	3
4	2	2			1		2		2				3	2
5	2	2			1		2		2				1	1

Suggested Learning Resources

Text Books				
Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Modern Machining Processes	P.C Pandey & H.S. Shan	Tata McGraw Hill	2017
2	Advanced Machining Processes	Hassan Abdel	Mc Graw Hill, Mechanical Engineering Series	2016
3	Production technology	HMT	Tata Mc Graw Hill	2012
Reference Books				
Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Metals hand book	ASME	ASME	Vol-3
2	High velocity forming of metals	F.M Wilson	Prentice Hall	2015
3	Non-Conventional Machining	P.K.Mishra	The Institution of Engineers (India) Text book series, Narosa Publishing House	2005

E-Resources:

1. https://www.youtube.com/watch?v=tPS6uTWySTs
2. https://www.youtube.com/watch?v=1MkWjVjNFhY&list=PLYY-vaDZXAyxyB8EY_-4FYfAXfHeNY0Li
3. https://www.youtube.com/watch?v=i-PgeWbDgq4
4. https://www.youtube.com/watch?v=Jg6YXvTO5FE&list=PLSGws_74K019wxc495SU84wTQ1u1AC
5. https://www.youtube.com/watch?v=jhM01_mwygg

SEMESTER: VI

PROFESSIONAL ELECTIVE

Course Name: WORK STUDY AND ERGONOMICS

Course Code	**21ME642**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P:S)	**2:2:0**	**SEE Marks**	**50**
Total Hours of Teaching-Learning	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Pre-requisites: Knowledge of Basic mathematics and sciences**.**

Course objectives:

1. Understanding the user-centered design process including form and color theory.
2. Understanding product metamorphosis, and ergonomics.
3. Implement the principles of ergonomics and how to apply the principles to industrial design.
4. Understand the importance and techniques of human biological data collection and experiments.
5. Obtain a knowledge and ability towards Accident Investigation and Safety Management.

Module – 1

PRODUCTIVITY: Definition of productivity, individual enterprises, task of management Productivity of materials, land, building, machine and power. Measurement of productivity, factors affecting the productivity, productivity improvement programs, wages and incentives.

WORK STUDY: Definition, objective and scope of work study. Human factor in work study. Work-study and management, work study and supervision, work study and worker.

08 Hours

Module - 2

INTRODUCTION TO METHOD STUDY: Definition, objective and scope of method study, activity recording and exam aids. Charts to record movements in shop operation – process charts, flow diagram, flow process charts, travel chart and multiple activity charts. (With simple problems)

MICRO AND MEMO MOTION STUDY: Charts to record movements at work place – principles of motion economy, Therbligs and classification of movements, Two Handed process chart, SIMO chart, and micro motion study. Development, definition and installation of the improved method, brief concept about synthetic motion studies. **08 Hours**

Module - 3

INTRODUCTION TO WORK MEASUREMENT: Definition, objective and benefit of work measurement. Work measurement techniques

WORK SAMPLING, need, confidence levels, sample size determinations, random observation, conducting study with the simple problems. **08 Hours**

Module – 4

STOP WATCH TIME STUDY: Time Study, Definition, time study equipment, selection of job, steps in time study. Breaking jobs into elements, recording information. Rating & standard Rating, standard performance, scale of rating, factors affecting rate of working, allowances and standard time determination. PREDETERMINED MOTION TIME STUDY (PMTS) METHOD TIME MEASUREMENT (MTM).

08 Hours

Module – 5

ERGONOMICS: Introduction, Areas of study under Ergonomics, System approach to Ergonomics model, Man-Machine System. Components of Man- Machine System and Their functions – Work capabilities of Industrial Worker, Study of Development of Stress in Human body and their consequences. Computer based ergonomics. **08 Hours**

COURSE OUTCOMES:

At the end of the course, the student will be able to:

COs	Course Outcomes
CO1	Apply the concepts of productivity, work study and management
CO2	Analyse the various method study charts with micro and memo motion study concepts
CO3	Illustrate the techniques of work measurement and work sampling
CO4	Apply the concepts of stop watch time study with PMTS
CO5	Illustrate the concepts of ergonomics to study the development of stress in human body

CO-PO Matrix:

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2	1					1			1		1	1
2	2	2	1					1			1		1	1
3	2	2	1					1			1		1	1
4	2	2	1					1			1		1	1
5	2	2	1					1			1		1	1

Suggested Learning Resources:

SN	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Introduction to work study	ILO	III Revised Edition	1981
2	Motion and Time study	Ralph M Barnes	John Wiley	8th Edition, 1985.
3	Motion and Time study	- Marvin E. Mundel	PHI	1st edition
4	Work Study and Ergonomics	S Dalela and Sourabh	Chand Publishers	3rd edition
References				
1	Human Factors in Engineering Design	S Sanders E J McCormick	Mc Graw Hill	6th Edition.
2	Industrial Engineering Hand book	Maynard.	Mc Graw Hill	5th Edition 2001
3	Engineered work Measurement	Karger and Bayha	Industrial Press	4th Edition 1991

E-Resources: https://nptel.ac.in/courses/112104222

SEMESTER: VI

OPEN ELECTIVE

Course Name: AUTONOMOUS VEHICLES

Course Code	**21ME651**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**2:2:0**	**SEE Marks**	**50**
Credits	**03**	**Exam Hours**	**03**
Total Number of Pedagogy Hours	**40**	**Total Marks**	**100**

Pre-requisites: Basic science and Mathematics

Course objectives:

1. **Foundation in Automotive Electronics and Autonomous Systems:** Develop a solid understanding of the evolution of automotive electronics, advanced driver assistance systems, and autonomous vehicles, including their historical context and significance.
2. **Sensor Technologies and Integration**: Master the principles, capabilities, and limitations of sensor technologies used in autonomous vehicles, while gaining insight into the challenges and strategies associated with integrating diverse sensor data.
3. **Computer Vision and Deep Learning for Autonomous Perception**: Gain proficiency in computer vision fundamentals and deep learning techniques, enabling you to comprehend and apply neural networks for interpreting visual data in autonomous driving contexts.
4. **Connected Car Ecosystems and Communication**: Acquire an in-depth understanding of connected car technology, including vehicle-to-vehicle and vehicle-to-infrastructure communication, security concerns, and the potential impact of emerging communication protocols.
5. **Autonomous Vehicle Technologies and Implementation**: Explore various levels of vehicle automation, learn about localization and path planning algorithms, delve into control systems, and grasp the importance of frameworks like ROS in developing and deploying autonomous vehicles.

Module – 1

Introduction: Evolution of Automotive Electronics-Basic Control System Theory applied to Automobiles-Overview of the Operation of ECUs -Infotainment, Body, Chassis, and Powertrain Electronics-Advanced Driver Assistance Systems-Autonomous Vehicles. **8 Hours**

Module - 2

Sensor Technology for Autonomous Vehicles: Basics of Radar Technology and Systems-Ultrasonic Sonar Systems – LIDAR Sensor Technology and Systems – Camera Technology - Night Vision Technology - Use of Sensor Data Fusion - Kalman Filters **8 Hours**

Module – 3

Computer Vision and Deep Learning for Autonomous Vehicles: Computer Vision Fundamentals-Advanced Computer Vision-Neural Networks for Image Processing–Tensor Flow-Overview of Deep Neural Networks –Convolutional Neural Networks. **8 Hours**

Module - 4

Connected Car Technology: Connectivity Fundamentals- DSRC (Direct Short-Range Communication) - Vehicle- to - Vehicle Technology and Applications- Vehicle- to - Road side and Vehicle - to- Infrastructure Applications – Security Issues. **8 Hours**

Module – 5

Autonomous Vehicle Technology: Driverless CarTechnology-DifferentLevelsofAutomation-Localization-PathPlanning.ControllerstoActuateaVehicle-PIDControllers-Model Predictive Controllers, ROS Framework. **8Hours**

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Describe the evolution of Automotive Electronics and the operation of ECUs.
CO2	Compare the different type of sensing mechanisms involved in Autonomous Vehicles
CO3	Discuss about the use of computer vision and learning algorithms in vehicles.
CO4	Summarize the aspects of connectivity fundamentals existing in a driverless car.
CO5	Identify the different levels of automation involved in an Autonomous Vehicle

CO-PO Matrix:

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1		2											3	3
2	3	3											2	3
3					2								3	3
4							1				1		2	2
5			3	3									3	3

Suggested Learning Resources:

SN	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Creating Autonomous Vehicle Systems	Shaoshan Liu, Liyun Li	Morgan and Claypool	2017
2	Autonomous Driving: Technical, Legal and Social Aspects	Marcus Maurer	Springer	2016
3	Autonomous Vehicles for Safer Driving	Ronald.K.Jurgen	SAE International	2013
4	Autonomous Vehicle Technology: A Guide for Policymakers	James Anderson Kalra Nidhi Karlyn Stanly	R and Co	2014
5	Autonomy– Thequesttobuildthedriverlesscarandhowitwillreshapeourworld	Lawrence D.Burns, Chrostopher Shulgan	Harper Collins Publishers	2018
References				
1	Autonomous Vehicles	Christian Wolmar	London	First Edition 2018
2	Driverless: Intelligent Cars and the Road Ahead	Hod Lipson and Melba Kurman	MIT Press	First Edition 2016

E-Resources:

1. https://www.youtube.com/watch?v=tiwVMrTLUW
2. https://www.youtube.com/watch?v=NodzOaLJENo
3. https://www.youtube.com/watch?time_continue=3&v=_rxW68ADldI
4. https://www.youtube.com/watch?v=XKXbacNQGI8
5. https://www.youtube.com/watch?v=B8R148hFxPw
6. https://www.youtube.com/watch?time_continue=48&v=3yPMxV11KaA
7. https://www.youtube.com/watch?time_continue=116&v=2Gc1zz5bl8I
8. https://www.youtube.com/watch?v=Z7pFnMNFwDc
9. https://www.coursera.org/learn/intro-self-driving-cars
10. https://www.udemy.com/tutorial/autonomous-cars-deep-learning-and-computer-vision-in-python/a-brief-history-of-autonomous-vehicles/
11. https://www.sae.org/learn/content/c2012/
12. https://digitaldefynd.com/best-self-driving-cars-courses/

SEMESTER: VI

OPEN ELECTIVE

Course Name: SUPPLY CHAIN MANAGEMENT

Course Code	**21ME652**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**2:2:0**	**SEE Marks**	**50**
Credits	**03**	**Exam Hours**	**03**
Total Number of Pedagogy Hours	**50**	**Total Marks**	**100**

Pre-requisites: Basic science and Mathematics.

Course objectives:

1. Comprehensive Understanding: Gain a thorough comprehension of supply chain management fundamentals, its evolution, and its pivotal role in the economy.
2. Strategic Decision-Making: Develop the ability to make strategic decisions regarding sourcing, outsourcing, and supplier selection while considering factors like make vs. buy, core processes, and market vs. hierarchy dynamics.
3. Efficient Operations: Acquire proficiency in optimizing warehouse and distribution network management, including inventory control, material handling, distribution strategies, and facility location decisions
4. Optimization and Planning: Master supply chain optimization models, decision-making under uncertainty, and demand planning for multiple items and locations, while also understanding pricing and revenue management's impact on optimization.
5. Emerging Trends and Adaptability: Explore current supply chain trends, such as integration, information value, process restructuring, and IT applications, while preparing for the future by analyzing the potential of agile supply chains, reverse supply chains, and e-business integration.

Module – 1

Introduction: Supply Chain–Fundamentals–Evolution-Role in Economy-Importance- Decision Phases Supplier Manufacturer-Customer chain. -Enablers/Drivers of Supply Chain Performance. Supply chain strategy-Supply Chain Performance Measures.
StrategicSourcingOutsourcing–MakeVsbuy-Identifyingcoreprocesses-Market Vs Hierarchy-Make Vs buy continuum-Sourcing Strategy-Supplier Selection and Contract Negotiation. Creating a world class supply base-Supplier Development-World Wide Sourcing. **8 Hours**

Module - 2

Warehouse Management Stores management-stores systems and procedures-incoming materials control stores accounting and stock verification Obsolete, surplus and scrap-value analysis-material handling transportation and traffic management-operationalefficiency-productivity-costeffectiveness-performancemeasurement. **8 Hours**

Module – 3

Supply Chain Network Distribution Network Design–Role-Factors Influencing Options, Value Addition–Distribution Strategies-Models for Facility Location and Capacity allocation Distribution Center Location Models **8 Hours**

Module - 4

Supply Chain Network optimization models. Impact of uncertainty on Network Design-Network Design, decisions using Decision trees. Planning Demand, -multiple item-multiple location inventory management. Pricing and Revenue Management. **8 Hours**

Module – 5

Current Trends: Supply Chain Integration - Building partnership and trust in Supply chain Value of Information: Bullwhip Effect - Effective forecasting - Coordinating the supply chain. Supply Chain restructuring, Supply Chain Mapping-Supply Chain process restructuring, Postpone the point of differentiation– IT in Supply Chain -Agile Supply Chains-Reverse Supply chain. Future of IT in supply chain-E Business in supply chain. **8 Hours**

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Recognize the frame work and scope of supply chain management.
CO2	Make out ware house management, transportation performance
CO3	realize the supply chain network distribution model and strategies
CO4	Optimize the supply chain network models
CO5	Comprehend the latest trends in SCM

CO-PO Matrix:

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3					3			3	3				
2		3				3			3	3	3			
3			3			3	3		3	3		3		
4	2			2		2			2	2				
5					2		2	2		2				

Suggested Learning Resources:

SN	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Supply Chain Management: Strategy, Planning, and Operation	Sunil Chopra and Peter Meindl	Pearson Education	7th Edition
2	Operations and Supply Chain Management	F. Robert Jacobs and Richard B. Chase	McGraw-Hill Education	16th Edition,2020
3	Supply Chain Logistics Management	Donald J. Bowersox, David J. Closs, and M. Bixby Cooper	McGraw-Hill Education	5th Edition,2019
References				
1	Introduction to Supply Chain Management Technologies	David Frederick Ross	CRC Press	2nd Edition,2019
2	Designing and Managing the Supply Chain	David Simchi-Levi, Philip Kaminsky	McGraw-Hill Education	4th Edition
3	Global Logistics and Supply Chain Management	John Mangan, Chandra Lalwani, and Tim Butcher	Wiley	3rd Edition,2016

E-Resources:

1. https://www.ibm.com/topics/supply-chain-management
2. https://www.sap.com/products/scm/what-is-supply-chain-management.html
3. https://www.gartner.com/en/articles/the-gartner-supply-chain-top-25-for-2022
4. https://www.edx.org/learn/supply-chain-management
5. https://www.coursera.org/courses?query=supply%20chain%20management
6. https://onlinecourses.nptel.ac.in/noc21_mg45/preview
7. https://nptel.ac.in/courses/110106045
8. https://www.udemy.com/course/sap-mm-training/
9. https://nptel.ac.in/courses/110105095

SEMESTER - VI

Course Name: **DESIGN LABORATORY**

Course Code	**21MEL66**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**0:0:2**	**SEE Marks**	**50**
Credits	**01**	**Exam Hours**	**03**
Total Number of Pedagogy Hours	**20**	**Total Marks**	**100**

Pre-requisites:

1. Knowledge on Theory of machines, Machine design, Vibration, and Tribology.

Course objectives:

1. To understand the concepts of natural frequency, logarithmic decrement, damping and damping ratio and techniques of balancing of rotating masses and influence of gyroscopic couple.
2. Validate the concept of the critical speed of a rotating shaft.
3. Conduct investigation on the equilibrium speed, sensitiveness, power and effort of a Governor.
4. Demonstrate the principles of pressure development in an oil film of a hydrodynamic journal bearing.
5. Demonstrate the concept of stress concentration using Photo elasticity.

PART - A
1. Determination of natural frequency, logarithmic decrement, damping ratio and damping coefficient in a single degree of freedom vibrating systems (longitudinal and torsional). 2. Balancing of rotating and reciprocating masses (Open-Ended Exercise) 3. Determination of critical speed of a rotating shaft 4. Determination of equilibrium speed, sensitiveness, power and effort of Porter/Watt/ Proell /Hartnell Governor.
PART - B
5. Determination of Pressure distribution in Journal bearing 6. Study the principle of working of a Gyroscope and demonstrate the Effect of gyroscopic Couple on plane disc. 7. Determination of Fringe constant of Photo-elastic material using Circular disc subjected to diametral compression. (Open Ended Experiment) 8. Demonstration of stress concentration using Photo-elasticity for simple components like plate with a hole under tension or bending, circular disk with circular hole under compression. 9. Determination of stresses in Curved beam using strain gauge.

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Compute the natural frequency of the free and forced vibration of single degree freedom systems, Critical speed of shafts and Carry out balancing of rotating masses.
CO2	Analyze the governor characteristics and Gyroscope
CO3	Determine Pressure distribution in Journal bearing
CO4	Analyse the strain induced in a structural member using the principle of photo-elasticity.
CO5	Analyse the stresses and strains using strain gauge in compression and bending test and stress distribution in curved beams.

CO-PO Matrix:

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	2	1									2	2
2	3	2	2	1									2	2
3	3	3	3	1									2	2
4	3	3	3	1									2	2
5	3	3	3	1									2	2

SEMESTER: VI

Name of the course: HEAT TRANSFER LABORATORY

Course Code	**21MEL67**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**0:0:2**	**SEE Marks**	**50**
Credits	**01**	**Exam Hours**	**03**
Total Number of Pedagogy Hours	**20**	**Total Marks**	**100**

Pre-requisites: Knowledge of Basic sciences and mathematics.

Course objectives:

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

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

PART-B
7. Determination of Stefan Boltzmann Constant.
8. Determination of LMDT and Effectiveness in a Parallel Flow and Counter Flow Heat Exchangers.
9. Experiments on Boiling of Liquid and Condensation of Vapour.
10. Performance Test on a Vapour Compression Refrigeration.
11. Performance Test on a Vapour Compression Air – Conditioner.

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Determine the thermal conductivity of a metal rod and overall heat transfer coefficient of composite slabs.
CO2	Determine convective heat transfer coefficient for free and forced convection and correlate with theoretical values.
CO3	Evaluate temperature distribution characteristics of steady and transient heat conduction through solid cylinder experimentally.
CO4	Determine surface emissivity of a test plate and Stefan Boltzmann constant
CO5	Estimate performance of a refrigerator and Air-conditioning, effectiveness of a fin and Double pipe heat exchanger

CO-PO Matrix:

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2		2					2	1		2	2	2
2	3	2		2					2	1		2	2	2
3	3	2		2					2	1		2	2	2
4	3	2		2					2	1		2	2	2
5	3	2		2					2	1		2	2	2

SEMESTER -VI

Course Name: MINI PROJECT

Course Code	**21MN68**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**----------**	**SEE Marks**	**50**
Credits	**02**	**Exam Hours**	**03**
Total Number of Pedagogy Hours	**20**	**Total Marks**	**100**

Mini-Project:

Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

Course outcomes:

At the end of the course the student will be able to:

CO1	Present the mini-project and be able to defend it.
CO2	Make links across different areas to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
CO3	Habituated to critical thinking and use problem solving skills.
CO4	Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
CO5	Work in a team to achieve common goal. And Learn on their own, reflect on their learning and take appropriate actions to improve it.

CO-PO Matrix:

COs	**Program Outcomes (POs)**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1		2			3		3					2	2	2
2		2	2	2	3							2	2	2
3		2	1	1	3							2	2	2
4		2	1	1	3							2	2	2
5		1	1	1	3		2					2	2	2

CIE procedure for Mini - Project:

The CIE marks awarded for Mini - Project, shall be based on the evaluation of Mini - Project Report, Project Presentation skill and Question and Answer session in the ratio 50:25:25. The marks awarded for Mini - Project report shall be the same for all the batch mates.

Semester End Examination

SEE marks for the mini-project shall be awarded based on the evaluation of Mini-Project Report, Presentation skill and Question and Answer session in the ratio 50:25:25 by the examiners appointed by the University.

SEMESTER: VI

Course Name: INDUSTRIAL SAFETY

Course Code	**21ME653**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**2:2:0**	**SEE Marks**	**50**
Credits	**3**	**Exam Hours**	**03**
Total Number of Pedagogy Hours	**40**	**Total Marks**	**100**

Pre-requisites: Knowledge of Basic mathematics and sciences**.**

Course objectives:

1. The present course highlights the importance of general safety and its prevention.
2. It enables students to understand about mechanical, electrical sand chemical safety.
3. The Industrial safety course helps in motivating the students to understand the reason for fire
4. Its Controlling of fire by various means are highlighted.
5. Importance of chemical safety, labelling of chemicals, hand signals during forklift operations in industrial and aerodromes will help in to understand and apply the techniques in practical field.
6. A visit to campus, various labs, workshops, local industries and fire stations helps in analyzing the importance of safety and corrective measures through case studies.

Module – 1

General Terminology: accident, safety, hazard, safe, safety devices, safety guard, security, precaution, caution, appliance, slip, trip, fall. Ladders and scaffolding. Unsafe acts, reason for accidents, MSDS (material safety data sheet), computer Aided Hazard Analysis, International acts and standards OSHA, WHO. Environment act, control and abatement of environmental pollution-Biomedical waste. Lockout and tag out procedures. Safe material handling and storage. Risk analysis quantification. **8 Hours**

Module - 2

Introduction, toxicity of products of combustion – vapour clouds – flash fire – jet fires – pool fires – auto ignition, sources of ignition. Class A, B, C, D and E fire. Fire triangle, Fire extinguishers, Fire hazard and analysis, prevention of fire. Fire protection and loss prevention, steps after occurrence of fire. Notice-first aid for burns, Portable fire extinguishers. Fire detection, fire alarm and firefighting systems. Safety sign boards, instruction on portable fire extinguishers. **8 Hours**

Module – 3

PPE, safety guards, Mechanical hazards, workplace hazards, Forklift hazard control Safety while working with machine tools like lathe, drill press, power and band saws, grinding machines. Safety during welding, forging and pressing. Safety while handling Material, compressed gas cylinders, corrosive substance, waste drum and containers. **8 Hours**

Module – 4

Introduction to electrical safety, Indian standards on electrical safety, Electric hazards, effect of electric current on human body, causes of electrical accidents, prevention of electric accidents, PPE used.

Protection systems: Fuse, circuit breakers and overload relays – protection against over voltage and under voltage. Electric shock. Primary and secondary electric shocks, AC and DC current shocks. Safety precautions against shocks. Safety precautions in small and residential building installations. Safety procedures in electric plant. **8 Hours**

Module – 5

Introduction to Chemical safety, Labelling of chemicals, acid hoods. Handling of acids, eye washers and showers. Safety thinking, accident investigation, safety policy of the company, safety, loss prevention and control, check list for LPG installations, safety precautions using CNG, fire prevention and safety audit, confined space entry, risk assessment.
Work Safety: working on elevated heights / location, confined space . **08 Hours**

Course Outcomes:
At the end of the course the student will be able to:

CO1	Recognize the basic safety terms and international standards.
CO2	Identify the hazards and risk analysis around the work environment and industries.
CO3	Make out the types of fires extinguishers and to demonstrate the portable extinguishers used for different classes of fires.
CO4	Report the case studies by sharing experience of the employees working in housekeeping, laboratories like workshops, electrical labs, machine shops, electronics and computer laboratories.
CO5	Distinguish the chemical and electrical hazards for its prevention and control.

CO-PO Matrix:

COs	Program Outcomes (POs)													PSOs
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	1					1	1					1	1	
2	1						2	1				1	1	1
3	1						2						1	1
4	1									1			1	
5	1						2						1	1

Suggested Learning Resources:

SN	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Industrial Safety and Management	L M Deshmukh	McGraw Hill Education (India) private Limited	2005
2	Electrical Safety, fire safety and safety management	S.Rao,	R K Jain and Saluja Khanna Publishers	1997
3	Chemical process Industrial safety	K S N Raju	McGraw Hill Education (India) private Limited	2014
Reference Books				
1	The Environment Act 1986	Commercial Law Publishers (India) Pvt. Ltd	New Delhi.	2005
2	Water (Prevention and control of pollution) act 1974	Commercial Law Publishers (India) Pvt. Ltd	New Delhi.	9th edition 2008

E-Resources: https://archive.nptel.ac.in/courses/112/107/112107292/

SEMESTER: VI

Professional Elective-2

Course Name: Additive Manufacturing

Course Code	**21ME644**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**2:2:0**	**SEE Marks**	**50**
Credits	**3**	**Exam Hours**	**03**
Total Number of Pedagogy Hours	**20**	**Total Marks**	**100**

Pre-requisites: Knowledge of Basic mathematics, manufacturing processes and sciences**.**

Course objectives:

1. To know the principle methods, areas of usage, possibilities and limitations of the Additive Manufacturing technologies.
2. To be familiar with the characteristics of the different materials those are used in Additive Manufacturing.
3. To know the principles of polymerization and powder metallurgy process, extrusion-based system printing processes, sheet lamination processes, beam deposition processes, direct write technologies Direct Digital Manufacturing.
4. To get exposed to process selection, software issues and post processing.

Module – 1

Introduction and basic principles: Need for Additive Manufacturing, Generic AM process, stereo lithography or 3dprinting, rapid proto typing, the benefits of AM, distinction between AM and CNC machining, other related technologies- reverse engineering technology.

Development of Additive Manufacturing Technology: Introduction, computers, computer-aided design technology, other associated technologies, the use of layers, classification of AM processes, metals systems, hybrid systems, milestones in AM development.

Additive Manufacturing Process chain: Variations from one AM machine to another, metal systems, maintenance of equipment, materials handling issues, design for AM, and application areas.

8 Hours

Module - 2

Photo polymerization processes: Stereo lithography (SL), Materials, SL resin curing process, Micro-Stereo lithography, Process Benefits and Drawbacks, Applications of Photo polymerization Processes.

Powder bed fusion processes: Introduction, Selective laser Sintering (SLS), Materials, Powder fusion mechanism, SLS Metal and ceramic part creation, Electron Beam melting (EBM), Process Benefits and Drawbacks, Applications of Powder Bed Fusion Processes.

Extrusion-based systems: Fused Deposition Modelling (FDM), Principles, Materials, Plotting and path control, Bio Extrusion, Process Benefits and Drawbacks, Applications of Extrusion-Based Processes.

8 Hours

Module – 3

Sheet Lamination Processes: Materials, Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Gluing, Thermal bonding, LOM and UC applications. Beam Deposition Processes: introduction, general beam deposition process, description material delivery, BD systems, process parameters, typical materials and microstructure, processing–structure–properties relationships, BD benefits and drawbacks.

Direct Write Technologies: Background, ink –based DW, laser transfer, DW thermals pray, DW beam deposition, DW liquid-phase direct deposition. **8 Hours**

Module – 4

Guidelines for Process Selection: Introduction, selection methods for apart, challenges of selection, example system for preliminary selection, production planning and control.
Software issues for Additive Manufacturing: Introduction, preparation of cad models – the STL file, problems with STL files, STL file manipulation.
Post- Processing: Support material removal, surface texture improvements, preparation for use as a pattern, property enhancements using non-thermal techniques and thermal techniques. **8 Hours**

Module – 5

AM Applications: Functional models, Pattern for investment and vacuum casting, Medical models, art models, Engineering analysis models, Rapid tooling, new materials development, Bi-metallic parts, Remanufacturing.
Application: Examples for Aerospace, defense, automobile, Bio-medical and general engineering industries. Direct digital manufacturing: Align Technology, Siemens and phonak, DDM drivers, manufacturing vs. prototyping, life- cycle costing, future of direct digital manufacturing. **8 Hours**

Course Outcomes:

At the end of the course the student will be able to:

CO1	Demonstrate the knowledge of the broad range of AM processes, devices, capabilities and materials, software tools, processes and techniques that enable advanced/additive manufacturing.
CO2	Exhibit the knowledge of the broad range of AM processes like Photo polymerization, Powder bed fusion and extrusion.
CO3	Apply the concepts of Sheet Lamination, Direct Write Technologies.
CO4	Select the process and address the software issues.
CO5	Analyze the latest trends and business opportunities in additive manufacturing.

CO-PO Matrix:

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	1		3		3		2					2	2	3
2	1		3		3		2					2	2	3
3	1		3		3		2					2	2	3
4	1		3		3		2					2	2	3
5	1		3		3		2					2	2	3

Suggested Learning Resources:

SN	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Additive Manufacturing Technologies Rapid Prototyping to Direct Digital Manufacturing	I. Gibson l D. W. Rosen l B. Stucker	Springer New York Heidelberg Dordrecht, London	ISBN: 978-1-4419-1119-3 e-ISBN: 978- 1-4419- 1120-9
2	"Rapid Prototyping: Principles & Applications	Chua Chee Kai, Leong Kah	Fai World Scientific	2003
3	Rapid Prototyping: Theory	Ali K. Kamrani,	Springer	2006 Emand Abouel Nasr

	& Practice			
Reference Books				
1	Rapid Prototyping: Principles and Applications in Manufacturing	Rafiq Nooran	John Wiley & Sons	2006
2	Additive Manufacturing Technology	Hari Prasad, A.V. Suresh	Cengage	2019
3	Understanding additive manufacturing: rapid prototyping, rapid tooling, rapid manufacturing	Andreas Gebhardt	Hanser Publishers	2011

E-Resources:

1. https://archive.nptel.ac.in/courses/112/103/112103306/
2. https://www.vlab.co.in/broad-area-mechanical-engineering

SEMESTER: VI

ABILITY ENHANCEMENT COURSE
Course Name: FINITE ELEMENT METHODS LABORATORY

Course Code	**21ME690**	**CIE Marks**	**50**
Teaching Hours/Week (L: T:P)	**0:0:2**	**SEE Marks**	**50**
Credits	**01**	**Exam Hours**	**03**
Total Number of Pedagogy Hours	**20**	**Total Marks**	**100**

Pre-requisites: Knowledge of Basic Mathematics (Basic calculus - Differentiation and Integration, Differential Equations, Linear Algebra), and Solid Mechanics.

Course objectives:

1. To acquire fundamental knowledge of the finite element analysis procedure and also a basic understanding of Modeling and Analysis/Simulation software.
2. To learn the theory and characteristics of finite elements that represent engineering structures.
3. To formulate the problem, create geometry, discretize, and apply boundary conditions to solve problems of bars, trusses, beams, and rectangular plates (With Circular/Elliptical holes) to find stresses with different loading conditions.
4. To understand the concepts of 1D and 2D thermal problems with conduction and convection boundary conditions using modern tools.
5. To learn and apply the basic principles to carry out dynamic analysis to know the natural frequencies of different kinds of beams.

PRE-REQUISITES THEORY COMPONENT (Lecture)
Introduction to Finite Element Method: General steps, Engineering applications, and Advantages of the Finite Element Method. Potential energy method, Displacement method of finite element formulation. Convergence criteria, Discretization process, Introduction to Rayleigh-Ritz Method, Galerkin's Method, Numerical. **Types of elements**: 1D, 2D, and 3D, Node numbering, Location of nodes. Strain-displacement relations, Stress-strain relations, Plain stress and Plain strain conditions, and temperature effects. Introduction to Simplex, complex, and multiplex elements. **Software packages for Performing Finite Element Analysis (FEA):** ANSYS Package is used as a tool for Structural and Thermal Modules.

PART-A
1. Bars of constant cross-section area, tapered cross-section area, and stepped bar. 2. Trusses. 3. Stress analysis of a rectangular plate with a circular and elliptical hole. **(Along with theoretical Concepts and Numerical Problems)**

PART-B
4. Beams – Simply supported, cantilever, beams with point load, UDL, beams with varying load, etc. 5. Thermal Analysis – 1D & 2D problem with conduction and convection boundary conditions **(Minimum 4 exercises of different types)**

PART-C (Open-Ended Exercise only for demo)
6. Dynamic Analysis to find: a. Natural frequency of beam with fixed – fixed end condition b. Response of beam with fixed–fixed end conditions subjected to forcing function c. Response of Bar subjected to forcing functions 7. Simulation of basic models using Ansys Workbench.

COURSE OUTCOMES: At the end of the course, the student will be able to:

CO1	Recognize the concepts behind formulation methods and characteristics of FEM.
CO2	Use modern tools to formulate the problem, create geometry, discretize, and apply boundary conditions to solve problems of bars, truss, and rectangular plates (With circular/Elliptical Holes) to find stresses with different loading conditions.
CO3	Demonstrate the ability to obtain deflection of beams subjected to point, uniformly distributed, and varying loads and use the available results to draw shear force and bending moment diagrams.
CO4	Analyse and solve 1D and 2D heat transfer conduction and convection problems with different boundary conditions.
CO5	Carry out dynamic analysis and finding natural frequencies of beams, plates, and bars for various boundary conditions and also carry out dynamic analysis with forcing functions.

CO-PO Matrix:

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	2	1	2							1	2	2
2	3	3	2	1	2							1	2	2
3	3	3	2	1	2							1	2	2
4	3	3	2	1	2							1	2	2
5	3	3	2	1	2							1	2	2

Suggested Learning Resources:

SN	Title of the Book	Name of the Author's	Name of the Publisher	Edition and Year
Textbooks				
1	A first course in the Finite Element Method	Logan	D. L Cengage Learning	6th Edition, 2016
2	Finite Element Method in Engineering	Rao S. S	Pergaman Int. Library of Science	5th Edition,2010
3	Finite Elements in Engineering	Chandrupatla T	T R PHI	2nd Edition, 2013
References				
1	Finite Element Method,	J N Reddy	McGraw-Hill International Edition	3rd Edition, 2017
2	Finite Elements Procedures	Bathe K. J	PHI	2nd Edition
3	Practical Finite Element Analysis	Nitin S Gokhale	Finite to Infinite	2008

E-Resources:

1. https://archive.nptel.ac.in/courses/112/105/112105308/
2. https://archive.nptel.ac.in/courses/112/104/112104205

SEMESTER: VI

ABILITY ENHANCEMENT COURSE

Name of the course: SPREAD SHEETS FOR ENGINEERS

Course Code	**21ME690A**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**0:0:2**	**SEE Marks**	**50**
Credits	**01**	**Exam Hours**	**03**
Total Number of Pedagogy Hours	**20**	**Total Marks**	**100**

Course objectives:

1. To create different plots and charts
2. To compute different functions, conditional functions
3. To carryout iterative solutions for roots, multiple roots and optimization.
4. To carryout matrix operations
5. To carryout numerical integration using different methods

Sl. No	Experiments
1	**Charting:** Create an XY scatter graph, XY chart with two Y-Axes, add error bars to your plot, create a combination chart
2	**Functions:** Computing Sum, Average, Count, Max and Min, Computing Weighted Average, Trigonometric Functions, Exponential Functions, Using the CONVERT Function to Convert Units
3	**Conditional Functions:** Logical Expressions, Boolean Functions, IF Function, Creating a Quadratic Equation Solver.
4	**Iterative Solutions:** Using Goal Seek in Excel, Using the Solver to Find Roots, Finding Multiple Roots, Optimization Using the Solver.
5	**Matrix Operations:** Adding Two Matrices, multiplying a Matrix by a Scalar, Multiplying Two Matrices, transposing a Matrix, inverting a Matrix and Solving System of Linear Equations.
	Demonstration Exercises
6	**Numerical Integration**: The Rectangle Rule, The Trapezoid Rule, The Simpson's Rule, creating a User-Defined Function Using the Simpson's Rule.

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Create different plots and charts
CO2	Compute different functions and conditional functions.
CO3	Perform logical functions and Boolean operations
CO4	Carryout iterative solutions for roots, multiple roots and optimization.
CO5	Carryout matrix operations and numerical integration using different methods

CO-PO Matrix:

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	1		3		3		2					2	2	3
2	1		3		3		2					2	2	3
3	1		3		3		2					2	2	3
4	1		3		3		2					2	2	3
5	1		3		3		2					2	2	3

Suggested Learning Resources: Microsoft Excel 2019 Formulas and Functions, Mc Fedries Paul, Microsoft Press, U.S, 2019 Edition, Microsoft Excel all-in-one for dummies Paul Mc Fedries, Greg Harvey

SEMESTER: VI

ABILITY ENHANCEMENT COURSE

Course Name: INTRODUCTION TO MATLAB

Course Code	**21ME690B**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**0:0:2**	**SEE Marks**	**50**
Credits	**01**	**Exam Hours**	**03**
Total Number of Pedagogy Hours	**20**	**Total Marks**	**100**

Pre-requisites: Knowledge of Mathematics and Programming**.**

Course objectives:

1. To learn fundamental computer programming concepts such as variables, control structures, functions and many others.
2. To learn about various data types and how to handle them in MATLAB.
3. To learn the powerful support MATLAB provides for working with matrices.
4. To learn about file input/output.

Module - 1

Introduction to MATLAB Programming: Basics of MATLAB Programming, array operations in MATLAB, loops and execution of control, working with files: Scripts and functions, plotting and programming output, examples.

Module-2

Numerical Methods and their applications: Curve Fitting - Straight line fit, Polynomial fit

Module-3

Numerical Integration and Differentiation: Trapezoidal method, Simpson method.

Module-4

Linear and Nonlinear Equations: Eigen values, Eigen vectors, Solution of linear algebraic equations using Gauss Elimination and LU decomposition, Solution of nonlinear equation in single variable using Gauss-Seidel and Newton-Raphson method.

Module-5

Ordinary Differential Equations: Introduction to ODE's, Euler's method, second order Runge-Kutta method, MATLAB ode45 algorithm in single variable and multivariable. **Transforms:** Discrete Fourier Transforms.

COURSE OUTCOMES: At the end of the course, the student will be able to:

CO1	Identify loops, branching, control instruction and functions in MATLAB programming environment.
CO2	Examine program curve fitting.
CO3	Correlate numerical differentiation and integration,
CO4	Resolve linear and Non-Linear equations in MATLAB and solve engineering problems.
CO5	Illustrate ODE (Ordinary Differential Equations) using ode 45 and execute Solutions of nonlinear equations and DFT (Discrete Fourier Transforms) in MATLAB

CO-PO Matrix:

COs	**Program Outcomes (POs)**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	1	1	1		3							1	1	2
2	1	1	1		3							1	1	2
3	1	1	1		3							1	1	2
4	1	1	1		3							1	1	2
5	1	1	1		3							1	1	2

Pedagogy / Teaching-Learning Process (which are appropriately selected):

1. Adopt different type of teaching methods to develop the outcomes through Power-Point Presentation and Video demonstration or Simulations.
2. Disquisition method for Problem Solving.
3. Arrange visits to show the live working models other than laboratory topics.
4. Adopt collaborative Learning (Group Learning) in the class.
5. Adopt Problem Based Learning (PBL), which fosters students 'Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information.
6. Conduct Laboratory Demonstrations and Practical Experiments to enhance experiential skills.

Assessment Details for IPCC

Continuous Internal Evaluation (CIE): CIE for the theory component of IPCC is 30 marks

Sl. No.	Components	Number	Weightage	Max. Marks
1	Tests (A)	3	60%	18
2	Alternate Assessment Tools (AAT) (B)	3	40%	12
X	**Total Marks for theory component A+B**			**30**

CIE for the LAB component of IPCC: 20 marks

Sl. No.	Components	Weightage	Max. Marks
1	Lab Work: Conduction of Experiments (A)	40%	08
2	Lab Journal Writing & Submission (B)	10%	02
3	Lab Test (C)	30%	06
4	Open-Ended Experiments / Mini Lab Projects (D)	20%	04
Y	**Total Marks**		**20**

Final CIE Marks = X + Y

Semester End Examination (SEE)

SEE for IPCC Theory for 3 hours duration

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
- The students have to answer 5 full questions, selecting one full question from each module. The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component)
- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included. The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Assessment Details for PCC

CIE:

Tests (A): Topics taught by Lecture hours need to be assessed and this will contribute to 30 marks.

	Components	Number	Weightage	Max. Marks
(i)	Tests (A)	3*	60%	30
(ii)	Alternate Assessment Tools (AAT) (B)	3-4	40%	20
	Total Marks			50

Final CIE Marks = (A) + (B)

Semester End Examination (SEE)

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.
- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

ABILITY ENHANCEMENT COURSE (AEC):

Assessment Details of CIE

	Components	Number	Weightage	Max. Marks
(i)	Tests (A)	3	60%	30
(ii)	Alternate Assessment Tools (AAT) (B)	3	40%	20
	Total Marks			50

Final CIE Marks = (A) + (B)

Semester End Examination (SEE): SEE Guidelines for the Courses

a. 21AD580 – Advanced Aptitude

b. 21ME581 – 3D Printing Lab

c. 21ME690 – Finite Element Analysis

d. 21ME690 A – Spread sheets for Engineers

e. 21ME690 B – Introduction to MAT LAB

1. SEE will be conducted with common question papers for the subject.
2. SEE Pattern will be in MCQ Model (Multiple Choice Questions) for 100 marks which will be scaled down to 50 marks.
3. Duration of the examination is 02Hours

Alternate Assessment Tools (AAT)
The following are the Alternate Assessment Tools (AAT) and not limited to: Quiz, Assignments, Presentations, Paper Publications, MOOCs, Industrial Visits and Report Writing, Open Book, Self E-Learning with Certifications and other cooperative and problem-based learning.

Assessment Details for PRACTICAL

Continuous Internal Evaluation (CIE)

	Components	Weightage	Max. Marks
1.	Lab Work: Conduction of Experiments (A)	40%	20
2.	Lab Journal Writing & Submission (B)	10%	05
3.	Lab Test (C)	30%	15
4.	Open-Ended Experiments / Mini Lab Projects (D)	20%	10
	Total Marks		**50**

Semester End Examination (SEE)

Semester end examination (SEE) will be conducted for 100 marks and proportionally reduced to 50 marks.

The pattern of SEE and scheme of evaluation:

Sl. No.	Components	Max. Marks
1	One Experiment from Part – A	**30**
2	One Experiment from Part – B	**50**
3	Viva – Voce	**20**
	Total	**100**

Question paper pattern:

- All the experiments are included for the external practical examination.
- There will be two parts A, B one question from each section need to be answered.
- **Part A** carries 40% and **Part B** carries 60%
- **Marks distribution**: **Procedure** (20%) + **Execution** (60%) + Viva Voce (20%)
- Students can pick one experiment from the questions lot prepared by the examiners.
- Change of experiment is allowed only once and 50% marks allotted to the procedure part to be made zero.

Department of Mechanical Engineering

ACTION TAKEN ON STAKEHOLDERS FEEDBACK

Employer Feedback

As per the employer survey feedback the following are the concerns raised and corresponding action taken.

1. **The employer has observed the lesser industry visits and technical exposure of the students.**

Action report:

The institution has organized industrial visit for Mechanical students and provided real time technical exposure to the students.

Faculty Feedback

As per the faculty feedback the following are the concerns raised and corresponding action taken.

1. **One of the senior faculty has raised the concern about requirement of certain content in the subject DME-1. The course needs to be restructuring and breaking down the vast syllabus in to segments during the revision of the syllabus.**

Action report:

-

The institution has restructuring the course content on DME-1 subject in the new curriculum which was effective from 2023-24.

Graduate feedback

As per the Graduate feedback the following are the concerns raised and corresponding action taken

1. **Suggested to conduct skill development training courses on design based mechanical software's in the department.**

Action report:

The institution has organized courses / trainings on CATIA, NX-12 and FMS in the department.

Alumini Feedback

As per the Alumini feedback the following are the concerns raised and corresponding action taken

1. **One of the alumini suggested that encourage the students and faculties to learn new design software's in the department**

Action report:

The department has encouraged and organized design software training from Medini technologies for faculties in the department

H.O.D.

Head of the Department
Dept. fo Mechanical Engineering
Ballari Institute of Technology & Management
(Formerly Bellary Engineering College)
BELLARY-583 104.

Ballari Institute of Technology and Management Ballari

Department of Mechanical Engineering

Date:20/02/2024

Circular

It is hereby informed to all the BE 7th Sem students that, Unigraphics NX-12 training will be start from 21st Feb 2024.

Venue: Mechanical Dept -CAD lab -2

Training Duration

- Training will involve both theoretical and practical
- Students will have 6 hours training every day

Note: All the registered students attend the training without fail

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Co-ordinator

Raghyendra K & Irrayya S

Ballari Institute of Technology and Management, Ballari
Department of Mechanical Engineering
NX-11 Skill Development Program
Students: BITM Final Year (2023-24)
List of Students Joined for NX-12 Training

Batch No.1

Sl. No	Name of the Student	USN
1	PRASHANTA A	3BR20ME001
2	ANIT SINGH	3BR20ME006
3	VIRUPAKSH REDDY	3BR20ME007
4	DARSHAN HIREMATH	3BR20ME008
5	DARSHAN KUMAR G	3BR20ME009
6	DEEPAK KUMAR	3BR20ME010
7	KAUSHAL KUMAR	3BR20ME012
8	KEDARANATHA PANNA S M	3BR20ME013
9	KHAJA MOINUDDIN C	3BR20ME014
10	PRAVEENKUMAR K	3BR20ME021
11	MADHUKUMAR R	3BR20ME016
12	MAHAMADAYAN A PAILWAN	3BR20ME017
13	MOHAMMAD SAKHIB B	3BR20ME018
14	S R NAVEEN KUMAR	3BR20ME022
15	SIDDHARTHA REDDY	3BR20ME023
16	SANTHOSHA H	3BR20ME024
17	RAHIL BASHA U	3BR21ME498
18	SHASHI KUMAR G	3BR20ME026
19	VINEETH REDDY G	3BR20ME028
20	KARTIKEYAN.V.KADAM	3BR20ME029
21	AHISHEK ACHARI B	3BR21ME400
22	ANANDA B	3BR21ME406
23	BALAJI L	3BR21ME416
24	BALLARAPU VIJAYA SIMHA REDDY	3BR21ME417
25	CHETAN KUMAR B	3BR21ME424
26	DHANARAJ	3BR21ME428
27	DHEERAJ SINGH	3BR21ME429
28	GAJULA RAKESH	3BR21ME435
29	HUSENBASHA	3BR21ME443
30	KIRANAKUMARA	3BR21ME450
31	KIREETAPPA K	3BR21ME451
32	M AJAY KUMAR	3BR21ME455
33	M S IRFAN ALI	3BR21ME457

34	MADHUSUDAN A V	3BR21ME458
35	MAHADEVA	3BR21ME459
36	MAHESHA G	3BR21ME462
37	GANESH PP	3BR21ME436
38	MANIKANTA	3BR21ME464
39	MANJUNATHA SWAMY H M	3BR21ME467
40	MANOJ H	3BR21ME468
41	MANOJ KUMAR REDDY C	3BR21ME469
42	MD KHAIS	3BR21ME470
43	HYDER NAWAZ	3BR21ME471
44	MOHAMMAD ASEEF M	3BR21ME472
45	MOHAMMED FAREED R	3BR21ME473
46	MOHAMMED IMDAD ALI	3BR21ME474
47	MOHAMMED RIZWAN K	3BR21ME476
48	MOHAMMED SOHAIL RAZA S	3BR21ME479
49	MOHAMMED YOUSUF B	3BR21ME480
50	MUDASSIR	3BR21ME481
51	MUHAMMAD GHOUSE	3BR21ME482
52	MUTTHANNA B	3BR21ME483
53	NAGARAJ	3BR21ME485
54	PAVAN KUMAR V	3BR21ME493
55	PRADEEP U	3BR21ME495
56	PRASHANTH H M	3BR21ME496
57	RAHUL SATPAD K	3BR21ME499
58	RAJ KUMAR	3BR21ME501
59	S MOHAMMED BASHA	3BR21ME506
60	S MOHAMMED DASTIGIR	3BR21ME507
61	MD THOUSIF	3BR21ME508
62	SHADAF NAWAZ	3BR21ME515
63	SHAHID HUSSAIN S	3BR21ME516
64	SHEKAR	3BR21ME517
65	SHIVAKUMAR M	3BR21ME518
66	SHIVARAJ D	3BR21ME519
67	SRINATH YADAV G	3BR21ME522
68	SUNEELA	3BR21ME524
69	SURESHA KUMARA M	3BR21ME526
70	SYED HASEEB UR RAHMAN	3BR21ME527
71	THARUN K	3BR21ME529
72	USMANE GANI ZUNNU RAIN A	3BR21ME534
73	RAJESH CHOWDARY	3BR21ME500

74	VAMSHI SAGAR M	3BR21ME537
75	VEERESH	3BR21ME538
76	VEERESH V	3BR21ME539
77	VIKRAM	3BR21ME542
78	B SRIKANTH	3BR21ME415
79	B MAHENDRA REDDY	3BR21ME412
80	MA MUSTAFA KHAZI	3BR21ME454

29.12.24

HOD

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UNIGRAPHICS NX-11

LABORATORY MANUAL

V SEMESTER, MECHANICAL ENGINEERING

Ballari Institute of Technology and Management Ballari

SYLLABUS

1. Introduction

Product Realization Process, Brief History of CAD/CAM Development, Definition of CAD/CAM/CAE,

2. Getting Started

Starting an NX 11 Session and Opening files, Printing, Saving and Closing files, NX 11 Interface, NX 11 Gateway, Ribbon bar, Quick Access Toolbar, Command finder, Top-border, Resource bar, Part Navigator, history, Cue line, Geometry Selection, feature selection, general object selection, User Preference, Visualization, Applications, Layers, Layers control, Commands in Layers, Coordinate Systems, Absolute Coordinate System, Work Coordinate System, Moving the WCS, Translate the WCS, Rotate the WCS, Toolbars

3. Two Dimensional Sketching

Overview, Sketching environment, Sketch Curve Toolbar, Constraints Toolbar, Dimensional Constraints, Geometric Constraints, Display Sketch Constraints, Show/Remove Constraints,

4. Exercises

Course Objectives

- To impart fundamental knowledge of CAD software
- To improve the visualisation skills and understand the conventions used in engineering drawing.
- To enable the students with concepts of dimensioning and standards related to sketching.
- Recognize to use engineering tools, software for drawing and engage in lifelong learning

Couse Outcomes

- Understand the computer Aided drafting software
- Improve their visualization skills.
- Make component sketching.
- Engage in lifelong learning using sketching and drawing as communication tool.

UNIGRAPHICS NX-11

LABORATORY MANUAL

VI SEMESTER, MECHANICAL ENGINEERING

Ballari Institute of Technology and Management Ballari

SYLLABUS

1. Three Dimensional Modeling

Types of features, Primitives, reference features, Swept features, remove features, extract features, user-defined features, Primitives, i) model a Block ii) model a shaft iii) model a cone iv) model a sphere , feature operations - Edge Blend, Chamfer, Thread, Trim Body, Split Body, Mirror, Pattern, Boolean Operations-Unite,substract,intersect,

2. **Drafting**

Overview, creating a drafting, Dimensioning, product and manufacturing information,

3. **Exercise on modeling and drafting of standard mechanical parts**

4. Assembly Modeling

Terminology related to assembly, assembling approaches-Top up and Bottom down approaches, assembly navigator, and exercises

Course Objectives

- To impart fundamental knowledge of drawing of different machine parts
- To enable the students with concepts of dimensioning and standards related to drawings
- To enable the students draw the assembly of various machine components
- Recognize to use engineering tools, software for drawing and engage in lifelong learning

Couse Outcomes

- Understand the machine parts
- Make component drawings.
- Produce the assembly drawings using part drawings

YADAVALLI BASAVARAJ

Digitally signed by YADAVALLI BASAVARAJ
DN: cn=YADAVALLI BASAVARAJ c=IN o=Personal
Reason: I am the author of this document
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Date: 2024-12-19 12:20+05:30