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Phone No. 0863 - 2399999, www.kluniversity.in
Admin Off: 29-36-38, Museum Road, Governorpet, Vijayawada - 520 002. Ph: +91-866-2577715, Fax: +91-866-2577717

Department of Mechanical Engineering

(DEEMED TO BE UNIVERSITY)

Board of Studies Meeting

12-12-2022

Koneru Lakshmaiah Education Foundation
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Phone No. 08645-350200, 350345, www.kluniversity.in

To
The Dean -Academics
K L Deemed University
Vaddeswaram

Dear Sir,

Sub: Minutes of the 23rd BOS meeting-Mechanical Department held on 12-12-2022 in room no.M117(HOD Chamber).,

The 23rd BOS of Mechanical Department for 2022-23 Even Sem is conducted on 12-12-2022 from 03:00 PM to 4:00 PM in room no.M117(HOD Chamber). The details of minutes and annexures of BOS conducted is attached below.

Thanking You,

Yours sincerely

12/12/22

Dr.T.Vijaya Kumar
Chairman BOS -ME

Dr. T. VIJAYA KUMAR
HOD-Mechanical Engineering
Koneru Lakshmaiah Education Foundation
(Deemed to be University)
Green Fields, VADDESWARAM-522 302.

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Minutes of the 23rd BOS meeting, Mechanical Department held on December 12th 2022 in room no. M117(HOD Chamber) form 3:00 PM to 4:00 PM

AGENDA ITEMS

1. To present the significant events of the Department for 2022-23 odd sem.
2. To discuss and approve the recommendations of DAC-1 & DAC-2.
3. To consider and approve the changes in the curriculum of M.Tech-Machine Design and M.Tech-Thermal Engineering.
4. To consider and approve the curriculum for the new M.Tech program-Product Life Cycle(PLM).
5. Any other points with the permission of the Chair.

AGENDA and RESOLUTIONS

AGENDA ITEM-1

Significant events A.Y.2022-23 Odd Sem	Resolution Passed
Honours received by Faculty • **Dr. B. Nageswara Rao** received **Excellence Service Award** by INSO Awards (International Scientist Awards on Engineering, Science and Medicine) • **Dr. K. Rama Krishna** received **IEOM Global Engineering Education Award** IEOM International Society • **Dr. K. V. Narasimha Rao** received Indian World Record as **"First Indian to register 30 Intellectual Property Rights, in just 24 Hours" on 12/09/2022"** by Indian Book of Records. • **Dr. B. Nageswara Rao** received **Top Ranked Researchers In World 2% Researchers Category 2022** by Elsevier • **Dr. G. Murali** received **Best Researcher Award** Saveetha School of Management, ESN Publications **Honours received by Students** • **Mr. P. Srimannarayana Raju (150070323)** secured **3rd place in Additive Manufacturing skill at World Skills Competitions 2022** Special Edition. Soest. Germany. • **58 Students from III/IV B.Tech (ME)** Completed NPTEL Online Certification on "Introduction to Internet of Things" with a valid score, apart of Industry 4.0 and design of cyber physical systems Course offered in III Year Odd Sem **Placements** • 94 Placement offers were received by 78 registered students. • The maximum package offered was 12 lakh and minimum of 3.2 lakhs with an average package of 5 lakhs per annum. **Ph.D Awards** • Mr. Khot Rahul Shivaji, scholar of Dr. K. V. Durga Rajesh was awarded Ph.D in the month of September-2022. • Mr. Kedar Sridhar Ashok, scholar of Dr. G. Murali was awarded Ph.D in the month of September-2022.	BOS appreciated all the achievers of the department both faculty and students and congratulated the department faculty and staff who helped students to achieve their goals. The detailed list of events in given in **Annexure-1.**

Dr. T. VIJAYA KUMAR 12/12/22
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• Mr. S. Sudhir A, scholar of Dr. K. Rama Krishna was awarded Ph.D in the month of November-2022. **Publications & Conference presesntations** • 75 papers were published in various International Journals in the A.Y.2022-23 till date. • 23 papers were presented by faculty in various International Conferences in the A.Y.2022-23 till date. **Patents & Consultancy** • Design patent- 1 filed, 2 published and 1 granted in the A.Y.2022-23 till date. • Utility patents-1 filed, 3 published, 1 granted in A.Y.2022-23 till date. • 5 faculty members have completed the consultancy work in the A.Y. 2022-23 till date BOS Chairman Congratulated all the award winners and achievers of the department.	

AGENDA ITEM-2

Recommendations of DAC-1 & DAC-2	Resolution Passed
By considering the feedback given by course coordinators of 2022-23 even Sem the following recommendations were made in DAC-1 & DAC-2. 1. Reverse Engineering and Additive Manufacturing courses are combined and is offered as 20ME4062-Reverse Engineering and Rapid Prototyping course for Y20 Batch students in III Year Even Sem-**Annexure-3(a)** 2. CO statements of 21ME2211-Kinematics of Machines are rephrased to suit the pedagogy adopted-**Annexure-3(b)** 3. 20ME4057-Sustainable Design & Social Innovation in Engineering Design and 20ME4067-Sustainable Design & Social Innovation in Smart Manufacturing are offered to Y20 batch students in III year Even Sem as project based courses. The evaluation (In-sem-1, In-sem-2 and End Sem) is based on project evaluation-**Annexure-3(c).** 4. The CO statement of 20ME4064-Flexible Manufacturing systems are rephrased to the suit the pedagogy adopted-**Annexure-3(d).** 5. The L-T-P-S of 20ME4061-Modern Manufacturing Processes is changed to 3-0-0-0 from 2-0-2-0 & 20ME4062-Reverse Engineering and Rapid Prototyping is changed to 2-0-0-4 from 2-0-2-0-**Annexure-3(e).**	It is resolved to approve the changes proposed by Course coordinators in DAC-1 & DAC-2 DAC minutes are given in -**Annexure-2**

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6. The CO statements of 20ME4104-Computaional Fluid Flow and Heat Transfer are rephrased to map the CO's to the higher BTL level-**Annexure-3(f).** 7. The syllabus of 20ME4053-Modelling Analysis & Design of Robotic systems is modified, since Y20 batch students are unaware of the fundamentals in Robotics-**Annexure-3(g)** 8. The CO Statements of 21ME2209-Numerical Computations for Mechanical Engineers are rephrased to suit the pedagogy adopted-**Annexure-3(h).**	

AGENDA ITEM-3

Curriculum of M.Tech-MD & M.Tech-TE for Y22 admitted Batch students	Resolution Passed
To offer more opportunities for M.Tech students 4 new elective courses are proposed in each stream of M.Tech -Machine Design **(Annexure-4)** and M.Tech-Thermal Engineering **(Annxure-5)** to Y22 admitted batch students	It is resolved to approve the new elective courses under M.Tech-MD and M.Tech-TE. The detailed structure of M.Tech-MD & M.Tech-TE is given in **Annexure-6.**

AGENDA ITEM-4

M.Tech-Product Life Management(PLM)-New Program	Resolution Passed
The new program M.Tech-Product Life Management(PLM) is proposed as per the MOU with BOSCH. The Syllabus and curriculum of the new program are sent to Bosch for vetting.	It is resolved to act according to the recommendations of Bosch after vetting. The detailed curriculum of the M.Tech-PLM program is given in **Annexure-7.**

Vijay Kumar

Dr. T. VIJAYA KUMAR
HOD-Mechanical Engineering
Koneru Lakshmaiah Education Foundation
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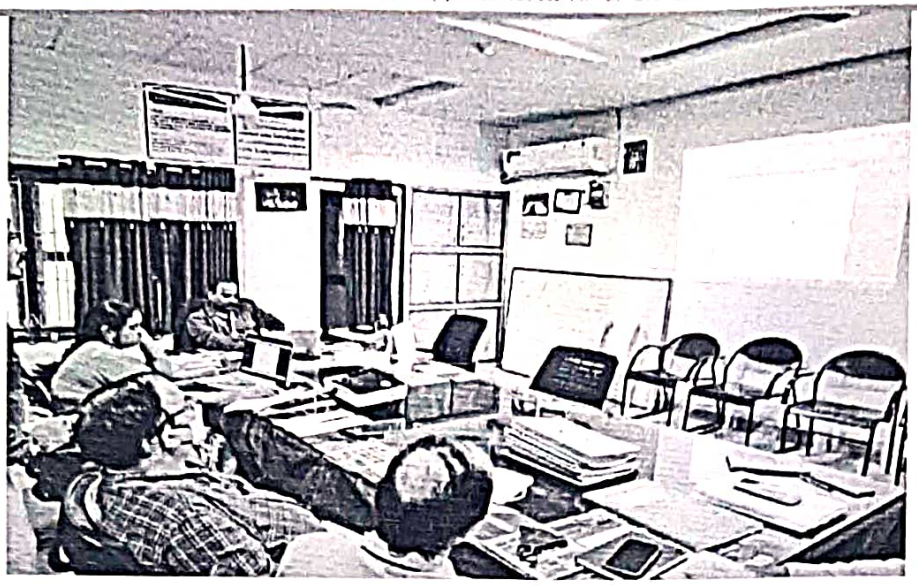
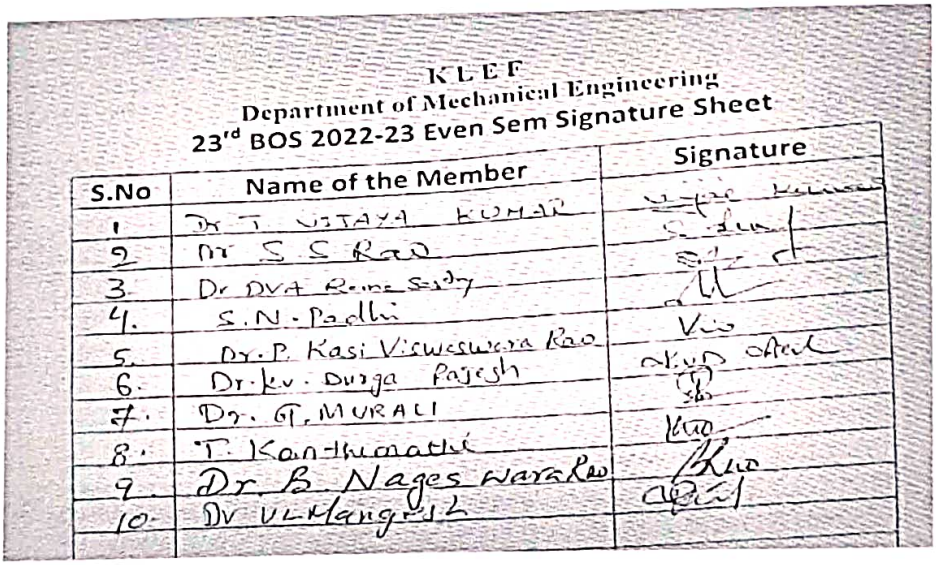


Dr. T. VIJAYA KUMAR
HOD-Mechanical Engineering
Koneru Lakshmaiah Education Foundation
(Deemed to be University)
Green Fields, VADDESWARAM-522 ...

Members Present

SL. NO	FULL NAME	DESIGNATION	ORGANIZATION	POSITIONIN THE MEETING
1	Dr. T.Vijaya Kumar	HOD-ME and Chairman-BOS	KLEF	Internal member
2	Dr.D.V.A Rama Sastry	Associate Professor	KLEF	Internal member
3	Dr.S.N.Padhi	Professor, Group Head, Design & manufacturing	KLEF	Internal member
4	Dr.S.S. Rao	Professor, Group Head, Robotics & Mechatrinics	KLEF	Internal member
5	Dr.G.Murali	Professor& Group Head, Energy & CFD	KLEF	Internal member
6	Dr.B.Nageswara Rao	Professor	KLEF	Internal member
7	Dr.P.Kasi V rao	Associate professor, Associate Dean Academics	KLEF	Internal member
8	Dr.K.V.Durga Rajesh	Associate Professor	KLEF	Internal member
9	Dr.V.L.Mangesh	Professor	KLEF	Internal member
10	Mrs. T.Kanthimathi	Assistant professor, Professor I/C Academics	KLEF	Internal Member



KLEF
Department of Mechanical Engineering
23rd BOS 2022-23 Even Sem Signature Sheet

S.No	Name of the Member	Signature
1	Dr T VIJAYA KUMAR	
2	Dr S S Rao	
3	Dr DVA Rama Sastry	
4	S.N. Padhi	
5	Dr. P. Kasi Viswesvara Rao	
6	Dr. K.V. Durga Rajesh	
7	Dr. G. MURALI	
8	T. Kanthimathi	
9	Dr. B Nages wara Rao	
10	Dr V.L Mangesh	

Dr. T. Vijaya Kumar

HOD-ME, Chairman BOS

Dr. T. VIJAYA KUMAR
HOD-Mechanical Engineering
Koneru Lakshmaiah Education Foundation
(Deemed to be University)
Green Fields, VADDESWARAM-522 302.

Annexures:

Annexure-I:

K L E F
Department of Mechanical Engineering

Significant Events happened in the Department from July-2022 to till date

1.0 Honours Received

1.1 Honours received by Faculty

Dept.	Name of the Faculty	Details of Honours	By
ME	Dr. B. Nageswara Rao	Excellence Service Award	INSO Awards (International Scientist Awards on Engineering, Science and Medicine)
ME	Dr. K. Rama Krishna	IEOM Global Engineering Education Award	IEOM International Society
ME	Dr. K. V. Narasimha Rao	Indian World Record as "First Indian to register 30 Intellectual Property Rights, in just 24 Hours" on 12/09/2022"	Indian Book of Records
ME	Dr. B. Nageswara Rao	Certificate of Recognition- Worthy oral Presentation	Magnus Group of organization
ME	Dr. B. Nageswara Rao	Top Ranked Researchers in World 2% Researchers Category 2022	Elsevier
ME	Dr. A. Sri Harsha	Completed NPTEL Online Certification on "Introduction to Internet of Things" with a score of 82% under Elite Category	NPTEL
ME	Dr. G. Murali	Best Researcher Award	Saveetha School of Management, ESN Publications

1.2 Honours received by Students

Dept.	Name of the Student	Details of Honours	By
ME	Mr. P. Srimannarayana Raju (150070323)	Got 3rd place in Additive Manufacturing skill at World Skills Competitions 2022 Special Edition, Soest, Germany	World Skills Competitions 2022 Special Edition on Additive Manufacturing was held from 13th to 16th October 2022 in Soest, at the University of Applied Sciences Südwestfalen, Germany
ME	58 Students from III/IV B.Tech (ME)	Completed NPTEL Online Certification on "Introduction to Internet of Things" with a valid	NPTEL

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		score, apart of Industry 4.0 and design of cyber physical systems Course offered in III Year Odd Sem	

1.3 Placements Details

Sl. No.	Company Name	No. of students selected	Package (in Lakhs)
1	TCS Ninja	12	3.86 LPA
2	TCS Digital	1	7 LPA
3	Nokia	1	6 LPA
4	Infosys through InfyTQ	2	3.6 LPA + Benefits
5	GA Morgan Dynamics	1	3.6 LPA
6	EPAM	1	12 LPA
7	Deloitte	3	7.6 LPA
8	MU Sigma	7	5 LPA
9	Hyundai Mobis	4	5.5 LPA + Benefits
10	CTS GENC	6	4 LPA
11	LTTS	5	4 LPA
12	NSL Hub	2	5 LPA
13	Mindtree	7	4 LPA
14	Accenture	3	4.5 LPA
15	KPIT	2	4.5 LPA
16	Geekbull	1	4.5 LPA
17	Tetrahedron Manufacturing	2	4 LPA
18	Amzur infotech	2	4 LPA
19	Media Mint	4	3.2 LPA
20	Savantis	11	3.2 LPA + Stipend 15K

Placements

- 190070010, 70051, 70061, 70071, 70102, 70130, 70139, 70140, 79007, 79009, 79030, 80005 – 12 Students of Y19 Batch Placed in TCS Ninja with 3.86 LPA.
- 190070015 – Mr. Ch. Faurddin – selected in TCS Digital with 7 Lakhs per Annum.
- 190079020 – Md. Safwan Ali - selected in Nokia with 6 Lakhs per Annum.
- 190070089, 190070113 - selected in Infosys through InfyTQ with 3.6 Lakhs per Annum + Benefits.
- 190080008 - Mr. S. Sai Ganesh - selected in GA Morgan Dynamics with 3.6 Lakhs per Annum with internship stipend of Rs. 12,500/-
- 190070020 – Mr. Hari Kiran Reddy Devireddy selected in EPAM with 12 Lakhs per Annum.
- 190070003, 70009, 70026 - 3 Students of Y19 Batch Placed in Deloitte with 7.6 LPA.
- 190070009, 70057, 70059, 70061, 70100, 70133, 80001 – 7 Students of Y19 Batch Placed in MU Sigma with 5 LPA.

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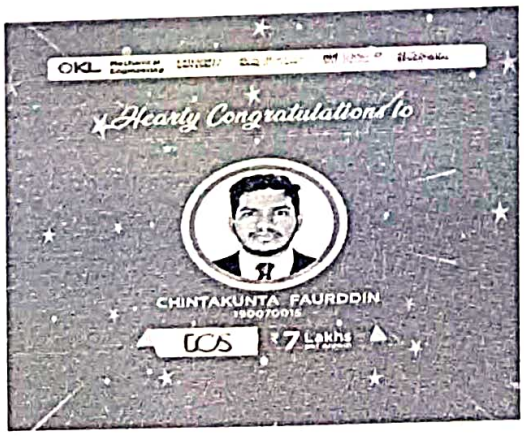
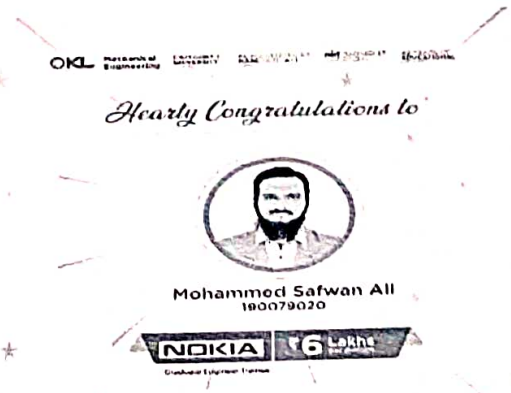
- 190070010, 70071, 70089, 79010 – 4 students of Y19 Batch Placed in Hyundai Mobis with 5.5 LPA.
- 190070003, 70059, 70070, 70137, 79002, 79022 - 6 students of Y19 Batch Placed in CTS GenC with 4 LPA.
- 190070082, 70105, 70132, 70137, 79015 - 5 students of Y19 Batch Placed in LTTS with 4 LPA.
- 190070132, 190079002 – Ms. P. Raja Satya Harika (190070132) and Mr. S. Y. Kalyan Reddy (190079002) selected in NSL Hub with 5 LPA.
- 190070055, 70070, 70105, 70132, 70139, 79012 and 80001 - 7 students of Y19 Batch Placed in Mindtree with 4 LPA.
- 190070082, 70105, 70020 – 3 students of Y19 Batch Placed in Accenture with 4.5 LPA.
- 190070055, 190070070 – 2 students of Y19 Batch Placed in KPIT with 4.5 LPA.
- 190079014 – 1 student of Y19 Batch Placed in Geekbull with 4.5 LPA.
- 190070073, 190080008 – 2 students of Y19 Batch Placed in Tetrahedron Manufacturing with 4 LPA.
- 190070062, 190070068 – 2 students of Y19 Batch Placed in Amzur infotech with 4 LPA.
- 190070096,190070047,190079005,190070077 - 4 students of Y19 Batch Placed in Media Mint with 3.2 LPA.
- 190079023,70065,70119,79025,80010, 70074,70069,79006,79028,79027, 70101(NCRT) - 11 students of Y19 Batch Placed in Savantis with 3.2 LPA + 15K Stipend.





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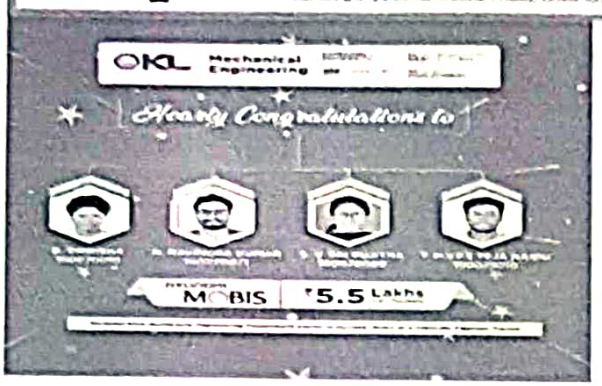

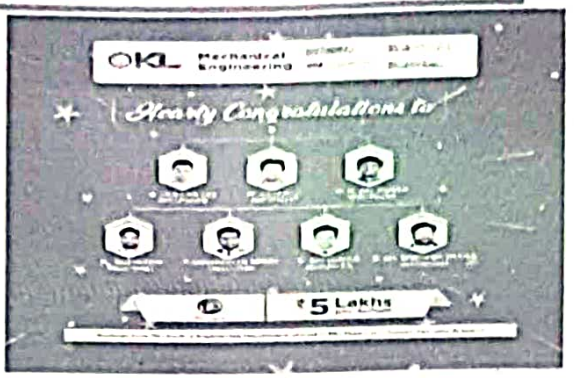

1.4	Ph.D. awarded

S. No.	Dept.	Name of the Faculty/Scholar	Name of the Supervisor	Month and Year
1	ME	Mr. Khot Rahul Shivaji	Dr. K. V. Durga Rajesh	September-2022
2	ME	Mr. Kedar Sridhar Ashok	Dr. G. Murali	September-2022
3	ME	Mr. S. Sudhir A	Dr. K. Rama Krishna	November-2022

2.0 Research Publications

2.1	Number of Papers Published by Faculty

S. No	Dept.	National Journals	International Journals
1	ME	-	75 (Till date for Calendar year 2022)

2.2	Number of Papers Presented by Faculty

S. No	Dept.	National Conferences	International Conferences
1	ME	-	23 (Till date for A.Y 2022-23)

3.0 Consultancy , Patents And Citations

3.1	Consultancy

S. No.	Name of the Faculty	Sponsoring Agency	Work

Dr. T. VIJAYA KUMAR
HOD-Mechanical Engineering
Koneru Lakshmaiah Education Foundation
(Deemed to be University)

1	Dr. S. S. Rao	Seeram Innovation pvt.ltd	Design and development of kinematic analysis of table top CNC machine tool
2	Dr. B. Nageswara Rao	Seeram Innovation pvt.ltd	Development of mathematical model to analyze kinematic motions of table top CNC machine tool
3	Dr. A. Srinath	APSSDC	Design and Development of Electromagnetic Braking System in Automobiles
4	Dr. G. Yedukondalu	APSSDC	Design and Development of 2-DOF Robot for Upper Limb Rehabilitation
5	Dr. P. V. Chalapathi	Sri Sowmithri Chemiteck	Identify productivity improvement areas and cost cutting areas

3.2 Patents

Patent Type	This Academic Year			Cumulative		
	Design	Utility	Plant	Design	Utility	Plant
Filed	1	1		159	6	
Published	2	3		1	23	
Granted	1	1		116	1	
Licensed				0	0	
Total	**4**	**5**	**0**	**276**	**30**	**0**

4.0 Seminars / Workshops

4.1 Workshops / Seminars Attended by the Department through Virtual/Offline Mode

S. No.	Dept.	No. of Faculty	Seminar / Workshop / Short Term Course
1	ME	13	Attended 3 days Hands on Workshop in Generative Design, CAM and PCB Design through AUTODESK-FUSION 360 sponsored by AUTODESK and conducted by DESIGNLABS Team from 21-11-2022 to 23-11-2022 organised by R&M Group

Vijay Kumar

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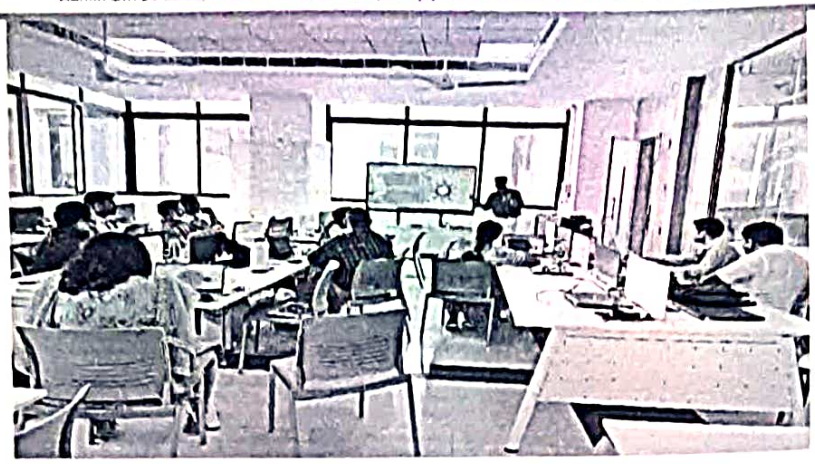

4.2	**Conferences/workshop/seminar Conducted by the Department through Virtual/Offline Mode**

S. No.	Dept.	Conference/Workshop/FDP/Seminar
1	ME	Conducted Seminar on "Overview and Importance of Higher Education and Opportunities" by Mr. Seshu Babu, Consultant, Center for International Admissions and Visas (CIAV), Guntur on 25-07-2022 by R&M Group.
2	ME	Conducted Seminar on "Hybrid awareness to the change makers in the society" for all ME & EEE Students of KLEF by Team of Experts from Toyota India on 20-09-2022 by D&M Group.
3	ME	Conducted Onsite training/workshop on "ANSYS & CFD" to ME Faculty from 08-09-2022 to 10-09-2022 by Mrs. M. Sangeetha, ANSYS Application Engineer, ARK Info solutions Pvt. Ltd., conducted by R&M Group.
4	ME	Conducted Seminar on Robotics and Automation in Industry 4.0, 5.0 and beyond on 14-11-2022 by Dr. Sudharsan Jayabalan, Robotics & Automation Society Chair, IEEE, Hyderabad Section conducted by R&M Group.
5	ME	Conducted 3 days Hands on Workshop in Generative Design, CAM and PCB Design through AUTODESK-FUSION 360 sponsored by AUTODESK and conducted by DESIGNLABS Team from 21-11-2022 to 23-11-2022 organised by R&M Group.

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5.0 Guest Lectures/Webinar

5.1 Guest Lectures/Webinar Arranged through Virtual/Offline Mode

S. No.	Dept.	Name of the Event	Date	On Topic
1	ME	Conducted **Alumni Guest Lecture on "Powerplant – Overview of deposits on Steam Turbine Blades"** by Mr. R.B.V Murali (11007003), Process Manager, TATA Consulting Engineering Limited, New Delhi by D&M Group	30-07-2022	**"Powerplant – Overview of deposits on Steam Turbine Blades"**
2	ME	**Conducted Alumni Guest Lecture on "Value Analysis and Value Engineering"** by Mr. T. Rakesh, Product Engineer, HCL Technologies, Chennai by R&M Group	27-08-2022	**"Value Analysis and Value Engineering"**
3	ME	**Conducted Alumni Guest Lecture on "Job Opportunities in Public Sector Companies"** by Mr. Y. Gangadhar, Deputy Manager (IT), APSRTC, Vijayawada, Andhra Pradesh by D&M Group	30-08-2022	**"Job Opportunities in Public Sector Companies"**

6.0 NSS Activities conducted through Virtual Mode

S. No.	Dept.	Details of NSS Activities	Conducted On
1	ME	Conducted Awareness program in reducing plastic usuage and to protect river krishna from pollution with KLUstudents, AWARA (Amaravathi Walkers and Runners Association) in collaboration with NDRF Team on 15-10-2022 at Sithanagaram	15-10-2022

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Annexure-2
DAC minutes
K L E F
DEPARTMENT OF MECHANICAL ENGINEERING

MINUTES OF DEPARTMENT ACADEMIC COMMITTEE (DAC)

KLEF/ ME/ IQAC - ACAD/AQ.5/ DCMs **Date: 18-11-2022**

The 23rd Department Academic Committee (DAC) Meeting was conducted at 1:45 P.M. on 18/11/2022 in HOD Cabin.

Agenda of the Meeting:

1. To discuss and approve the changes in the syllabus of courses offered in 2022-23 even semester as proposed by course coordinators
2. To consider the feedback given by stakeholders
3. To consider and approve the changes in the curriculum of M.Tech-Machine Design and M.Tech-Thermal Engineering
4. To consider and the curriculum for the new M.Tech program-Product Life Cycle(PLM)
5. Any other points with the permission of the Chair.

The following members were present:

1. Dr. D. V. A. Rama Sastry, Associate Professor & HoD, Chairman-DAC
2. Dr. S. S. Rao, Professor & R&M Group Head, Member
3. Dr. S.N.Padhi, Professor & Design & Manufacturing Group Head, Member
4. Dr. G.Murali, Professor & Energy & CFD Group Head
5. Dr. G.Diwakar, Professor, PG Coordinator, Member
6. Dr.T.Vijay Kumar, Associate Professor, III Year Coordinator, Member
7. Dr. P. Kasi V. Rao, Associate Dean-Academics, Member
8. Mr. B. Kiran Kumar, Assistant Professor, Course Coordinator
9. Dr. Priyaranjan Sharma, Professor, member
10. Mrs. T. Kanthimathi, Assistant Professor& Professor I/C Academics, Member

Minutes:

HOD welcomed all the members to the meeting and presented the agenda items before the members

1. As per the recommendation of group head, Elective Courses in Smart Manufacturing Specialization, Reverse Engineering and Additive Manufacturing are combined and 20ME4062-Reverse Engineering and Rapid prototyping is offered to Y20 Batch Students in III year Even sem.
It is proposed to approve the syllabus of 20ME4062.

Following are the modifications proposed by 2022-23 Even Sem Course coordinators

Vijay Kumar

Dr. T. VIJAYA KUMAR
HOD-Mechanical Engineering
Koneru Lakshmaiah Education Foundation
(Deemed to be University)
Green Fields, VADDESWARAM-522 302.

2. Dr.S.S. Rao, Course coordinator of 21ME2211- Kinematics of Machines course offered to Y21 Batch students in II year Even sem requested to rephrase the CO statement of CO-3 and CO-4 to suit to the pedagogy adopted
It is proposed to approve the changes in the CO statements of the course .

3. Dr.D.V.A Ramasastry, Course Coordinator of 20ME4057-Sustainable Design & Social Innovation in Engineering Design and Dr.Priyaranjan Sharma course coordinator of 20ME4067-Sustainable Design and Social Innovation in Smart Manufacturing proposed to offer both the courses as Project based. The In-Sem-1, In sem-II and Sem end evaluation are planned to be conducted based on the project work evaluation
It is proposed to approve the changes in the evaluation of both the courses.

4. Dr.K.V.Durga Rajesh, Course Coordinator of 20ME4064-Flexible Manufacuring Systems proposed to rephrase the changes in the CO Statement of CO-1, 3 & 4 to suit to the pedagogy adopted
It is proposed to approve the changes in the CO statements.

5. Mr.A.V.S.Ram Prasad, Course Coordinator of 20ME4061-Modern Manufacturing Process, Proposed to change the existing 2-0-2-0 L-T-P-S to 3-0-0-0. Mr.B.Kiran Kumar, Course coordinator of 20ME4062-Reverse Engineering and Rapid Prototyping, Proposed to change the existing L-T-P-S 2-0-2-0 to 2-0-0-4, to impart the required skills in both the courses. Further it is proposed to offer the two courses as project-based courses, based on the skills learnt by the students.
It is proposed to approve the changes in the L-T-P-S of both the courses.

7. Dr.K.Lokesh, Course coordinator of 20ME4104-Computaional Fluid Flow and heat Transfer offered to Y20 batch students in III year Even Sem proposed changes in CO-3 statement to map CO to higher BTL level.
It is proposed to approve the changes in the CO Statement of the course.

8. Dr.A.Sri Harsha, Course Coordinator of 20ME4053-Modelling Analysis & Design of Robotic Systems, proposed revision in the syllabus, since Y20 batch students are unaware of basic concepts of Robotics. Hence the syllabus is modified according to the need of the students.
It is proposed to approve the revision in the syllabus of the course.

9. To facilitate M.Tech students with more opportunities, upon discussion with Energy & CFD group members, Group head Dr.G.Murali, proposed 4 new elective courses to M.Tech-Thermal Engineering program offered to Y22 admitted batch students.
It is proposed to approve the new courses for M.Tech-TE

10. To facilitate M.Tech students with more opportunities, upon discussion with Design and manufacturing group members, Group head Dr.S.N.Padhi, proposed 4 new elective courses to M.Tech-Machine Design program offered to Y22 admitted batch students.
It is proposed to approve the new courses for M.Tech-MD

11. The new Program M.Tech-PLM(Product life Management) is proposed as per the MOU with BOSCH.. The curriculum is sent to BOSCH for review.

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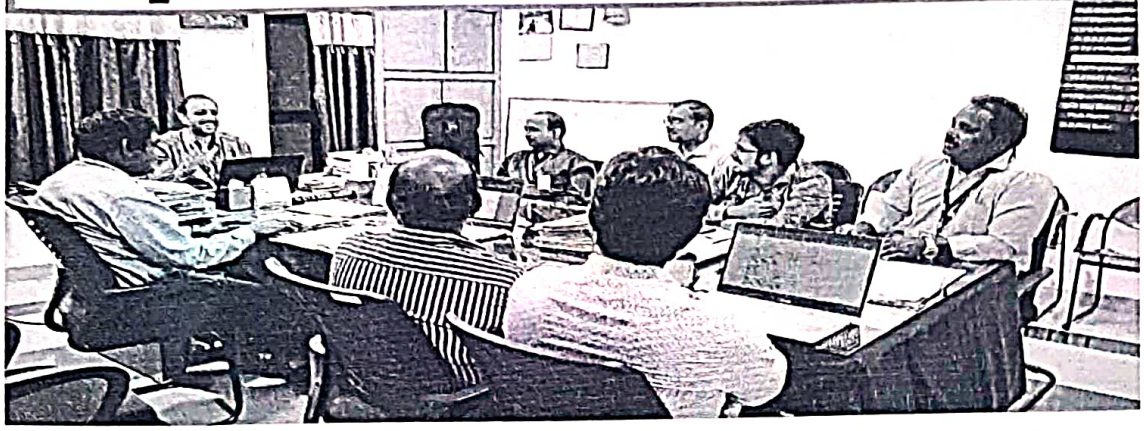

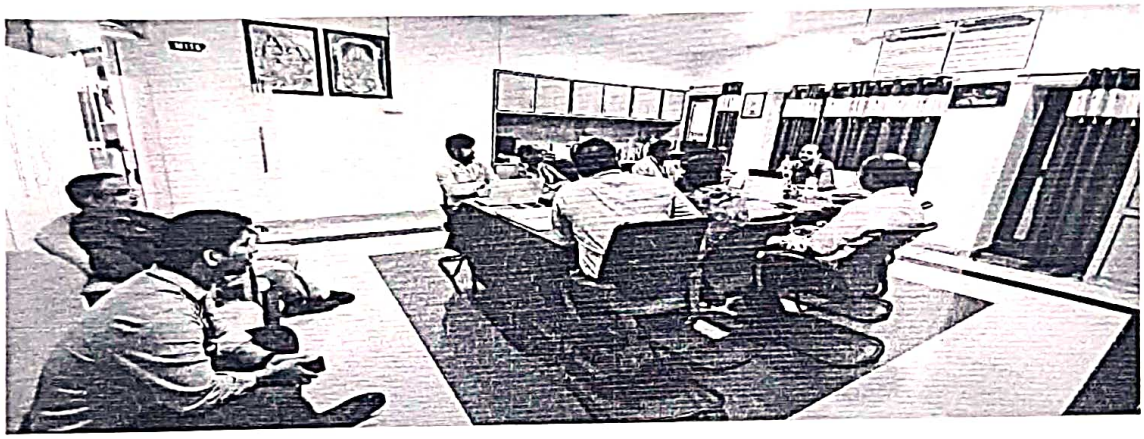

Prof I/C Academics
T. Kanthimathi

18/11/2021
CHAIRMAN- DAC

Annexure-3 (a)

20ME4062 – REVERSE ENGINEERING & RAPID PROTOTYPING

L-T-P-S: 2-0-0-4 **Credits : 3** **Pre-requisites : NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Understand the need of reverse engineering	PO1	2
2	Understand working principles of RP techniques	PO3	2
3	Understand Rapid tooling and RP case studies	PO3	2
4	Understand applications of RP techniques	PO3	2

Syllabus:

Reverse Engineering: Introduction, Need, RE taxonomy, RE types, RE Contact techniques, CMM, RE noncontact techniques, RE Applications. Definition of prototype, Types of Prototype, History (RP) systems, Classification of RP Systems.

Data processing for rapid prototyping, Liquid based techniques: Principle of operation, Machine details, Material, Process details of SLA, SGC, SCS, SOUP, two layer beams and applications.

Solid based techniques: Principle of operation, Machine details, Material, Process details LOM, FDM, PLT, MJM, MEM and applications.

Powder based techniques: Principle of operation, Machine details, Material, Process details of SLS, 3DP, LENS, DSPC, MJS, EBM and applications.

Rapid tooling and RP case studies: Introduction, Classification of RT routes- RP of Patterns, Soft tooling, production and bridge tooling, Aerospace Industries, Automotive Industries and Bio Medical application

Case Studies: Wind Tunnel Testing with Rapid Prototyped Models, RP applied to investment casting. integration of reverse engineering and rapid prototyping.

Text Books:

1. Karunakaran K.P,Vijay P Bapat, Ravi B —Rapid Prototyping And Tooling , Rapid Prototyping Cell, IIT-Mumbai.
2. Pham D T and Dimov S S, —Rapid Manufacturing , Verlag, (2001).
3. Paul F Jacobs, -Stereo lithography and other RP&M Technologies , SME, (1996).
4. ElancheZhian C,Sunder Selwyn T,Shanmuga Sundar G —Computer Aided Manufacturing , Laxmi Publications
5. Ali K Kamrani —Rapid Prototyping: Theory and Practice Publisher: Springer

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Annexure 2.5(b)

K L E F

DEPARTMENT OF MECHANICAL ENGINEERING

PROPOSED REVISIONS for DAC & BOS APPROVAL

Program: B.Tech Year/semester of study: II/II Academic year: 2022-2023

Course Title: KINEMATICS OF MACHINES Course Code: 21ME2211

Item	CO No	Existing	Proposed Modification	Justification for the proposed modifications	PO/PSO mapping* (ex:PO1-1 or PO1-2 or PO1-3)
Course Outcome	CO1				
	CO2				
	CO3	Construct cam profiles and Analyze gears and gear trains Kinematically	Construct and analyze cam profiles	gears and gear trains Kinematically also proposed in CO4	PO4
	CO4	Analyze gears and gear trains kinematically Analyze mechanisms dynamically	Analyze gears and gear trains kinematically	Allocated hours not sufficient to analyze mechanisms dynamically	PO2
	CO5				
Reference Books					

Existing Syllabus	Proposed Syllabus	Reasons for Changes in Existing Syllabus

***Note: For PO/PSO mapping the level of mapping to be considered is**

Level-1: Low level of mapping of the PO statement with the CO statement

Level-2: Medium level of mapping of the PO statement with the CO statement

Level-3: High level of mapping of the PO statement with the CO statement

For your reference, please see the next page for PO & PSO statements, the key words for each statement are highlighted

Course Coordinator

Dr. S. S. Rao

BOS Chairman

Dr. T. VIJAYA KUMAR
HOD-Mechanical Engineering
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Annexure-3(c)

09-12-2022

To
The Dean Academics,
KLEF.
Sir,

I herewith request you to consider to approve the follow evaluation plan for the Professional elective courses entitled **Sustainable design & Social Innovation in Engineering Design – 20ME4057 and Sustainable design & Social Innovation in Smart manufacturing – 20ME4067** both with **LTPS: 1-0-4-0.** These courses are terminal courses of their respective elective streams and are intended for making the learners to do a project using the knowledge, skills he/she acquired from other core and elective courses. Hence, the evaluation components of these courses are also selected with emphasis on project.

EVALUATION PLAN:

Evaluation Type	Evaluation Component	Weightage/Marks		Assessment Dates	Duration (Hours)	CO1	CO2	CO3	CO4
Blooms Taxonomy Level						2	3	3	6
In-Semester Summative Evaluation Total = 30 %	In-Sem Exam-I (Theory based)	Weightage	15		1	7.5	7.5		
		Max Marks	50M			25	25		
	In-Sem Exam -II (Project based)	Weightage	15		2			7.5	7.5
		Max Marks	50M					25	25
Formative Evaluation Total=30 %	ALMs	Weightage	8	Continuous Evaluation		2	2	2	2
		Max Marks	100M			25	25	25	25
	Home Assignment	Weightage	7	Continuous Evaluation		1.75	1.75	1.75	1.75
		Max Marks	40M			10	10	10	10
	Project Continuous evaluation	Weightage	15	Continuous evaluation		3.75	3.75	3.75	3.75
		Max Marks	100M			25	25	25	25
End-Semester Summative Evaluation Total = 40 %	SE Lab Proj.	Weightage	40	Lab External	1 ½	10	10	10	10
		Max Marks	100M			25	25	25	25

09/12/2022

Dr DVA Ramasastry,
Course coordinator of 20ME4057.
Assoc Professor, ME Department

Dr Priyaranjan Sharma,
Course coordinator of 20ME4067.
Assoc Professor, ME Department

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20ME4057-Sustainable Design & Social Innovation in Engineering Design

Item	CO No	Existing	Proposed Modification	Justification for the proposed modifications	PO/PSO mapping* (ex: PO1-1 or PO1-2 or PO1-3)
Course Outcome	CO1	Apply all fundamental concepts related to the streams in Engineering Design Specialization			PO1
	CO2	Identify the real-world problem and inculcate problem solving and critical thinking skills			PO1
	CO3	Develops a conceptual prototype on software tools			PO1
	CO4	Design and execute a fully functional prototype			PO4, PSO2
Reference Books					

Existing Syllabus	Proposed Syllabus	Reasons for Changes in Existing Syllabus
Fundamental concepts in Engineering Design Specialization. Hands-on experience on all relevant software tools	**Introduction:** Design and overview of the design process, design activities, design evolution, classic engineering design to manufacture model, overall design objectives. Design approach, philosophy, and normal approach design model. **Sustainable and its application within engineering design:** Design for sustainable manufacture, Design for sustainable use, Design for sustainable maintenance, Design for sustainable disposal, Measurement of sustainability. Tools of the designs process and management of Design, performance prediction	Since, the existing syllabus is not clearly defined, the syllabus is clearly mentioned.

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Annexure-3 (B)

SUSTAINABLE DESIGN & SOCIAL INNOVATION IN SMART MANUFACTURING

Course Code: 20ME4067 **Credits : 3** **L-T-P-S: 1-0-4-0**

Syllabus:

Introduction to design, overview of various design processes, Importance of sustainable design, various steps involved in sustainable design. Introduction to Innovation, examples of social innovation in manufacturing domain, social innovation for smart manufacturing.

Fundamental concepts in Smart Manufacturing, overview of smart manufacturing, building blocks for adopting smart manufacturing, i.e., Additive Manufacturing, Autonomous Robot, Augmented Reality, Big Data Analytics, Cyber Security, Cyber Physical System, Internet of things (IOT), Horizontal and Vertical System Integration, Simulation. Hands-on experience on relevant software tools, such as SOLIDWORKDS, LabVIEW, FUSION 360, ULTIMAKER CURA, UNITY, etc.

Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Apply all fundamental concepts related to the streams in smart manufacturing Specialization	PO1	3
CO2	Identify the real-world problem and inculcate problem solving and critical thinking skills	PO1	3
CO3	Develop a conceptual prototype	PO1	3
CO4	Design and execute a fully functional prototype	PO4, PSO1	5
CO5	Hands-on experience on relevant software tools, such as SOLIDWORKDS, ANSYS, FUSION 360, ULTIMAKER CURA, UNITY, etc	PO4, PSO1	5

Capstone Project:

Step-1: Define the problem and identify the objectives

Step-2: Research must be focused and incorporate new ideas and a thorough exploration of old similar ideas.

Step-3: The build process must take into consideration materials, processes, construction limitations, and cost.

Step-4: The entire project must be tested to see if it does the job for which it was designed.

References:

1. Johnson, A., & Gibson, A. (2014). Sustainability in engineering design. Academic Press.
2. Kheng, T. Y. (Ed.). (2021). Smart Manufacturing: When Artificial Intelligence Meets the Internet of Things. BoD–Books on Demand.
3. Tietz, M. A., Abdelgawad, S. G. S., & Pasquini, M. (2018). Social innovation: combining profits and progress. In *Social Innovation and Sustainable Entrepreneurship*. Edward Elgar Publishing.
4. Mladineo, M. (2022). Industry 4.0—from Smart Factory to Cognitive Cyberphysical Production System and Cloud Manufacturing.
5. Abubakr, M., Abbas, A. T., Tomaz, I., Soliman, M. S., Luqman, M., & Hegab, H. (2020). Sustainable and smart manufacturing: An integrated approach. Sustainability, 12(6), 2280.

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Annexure 3(d) Annexure 2(d)

K L E F
DEPARTMENT OF MECHANICAL ENGINEERING
PROPOSED REVISIONS for DAC &BOS APPROVAL

Program: B.Tech Year/semester of study: III / Even Academic year: 2022-2023
Course Title: Flexible Manufacturing Systems Course Code: 20ME4064

Item	CO No	Existing	Proposed Modification	Justification for the proposed modifications	PO/PSO mapping* (ex:PO1-1 or PO1-2 or PO1-3)
Course Outcome	CO1	Analyze various production schedules and plant layouts	Schedule machines in plant layouts	As BTL is mapped to 3, outcome was modified accordingly	PO2
	CO2	Apply the concept of group technology to the development of FMS	No change		PO2
	CO3	Identify hardware and software components of FMS	Assess performance of Flexible Manufacturing Systems	As existing CO is not appropriate, outcome was modified accordingly	PO2
	CO4	Analyze materials handling and storage system in FMS	Identify Manufacturing cells and hardware components of FMS	As existing CO is not appropriate, outcome was modified accordingly	PO2
	CO5	Implement NC part programming in part production	No Change		PO4

Course Coordinator

BOS Chairman
Dr. T. VIJAYA KUMAR
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Annexure-3(e)

20ME4064-Modern Manufacturing Processes

Program:B.Tech-Mechanical Year/semester of study:III/II A.Y: 2022-2023

Item	CO No	Existing	Proposed Modification	Justification for the proposed modifications	PO/PSO mapping* (ex: PO1-1 or PO1-2 or PO1-3)
Course Outcome	CO1				
	CO2				
	CO3				
	CO4				

Existing L-T-P-S	Proposed L-T-P-S	Reasons for Changes
2-0-2-0	3-0-0-0	To offer the course as project based course in combination with 20ME4062-Reverse Engineering and Rapid Prototyping

20ME4062-Reverse Engineering & Rapid Prototyping

Program:B.Tech-Mechanical Year/semester of study:III/II A.Y. 2022-2023

Item	CO No	Existing	Proposed Modification	Justification for the proposed modifications	PO/PSO mapping* (ex: PO1-1 or PO1-2 or PO1-3)
Course Outcome	CO1				
	CO2				
	CO3				
	CO4				
Reference Books					

Existing L-T-P-S	Proposed L-T-P-S	Reasons for Changes
2-0-2-0	2-0-0-4	To offer the course as project based course, skilling is imparted to the students.

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Annexure Annexure-3(5)

K L E F

DEPARTMENT OF MECHANICAL ENGINEERING

PROPOSED REVISIONS for DAC & BOS APPROVAL

Program: B. Tech | Year/semester of study: 3rd year, 2nd semester | Academic year: 2022-2023

Course Title: CFFHT | Course Code: 20ME4104

Item	CO No	Existing	Proposed Modification	Justification for the proposed modifications	PO/PSO mapping* (ex:PO1-1 or PO1-2 or PO1-3)
Course Outcome	CO1				
	CO2				
	CO3	Understand the modified equations of FD formulation	Apply FDM for advection-diffusion equations	Modification is to map the CO at higher BTL	PO2 - 3
	CO4				
	CO5				
Reference Books					

Existing Syllabus	Proposed Syllabus	Reasons for Changes in Existing Syllabus

***Note: For PO/PSO mapping the level of mapping to be considered is**

Level-1: Low level of mapping of the PO statement with the CO statement

Level-2: Medium level of mapping of the PO statement with the CO statement

Level-3: High level of mapping of the PO statement with the CO statement

For your reference, please see the next page for PO & PSO statements, the key words for each statement are highlighted

Course Coordinator

10/11/22

Dr. G. Murali

(Group head)

BOS Chairman

Dr. T. VIJAYA KUMAR
HOD-Mechanical Engineering
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Annexure-3.8)

KLEF

DEPARTMENT OF MECHANICAL ENGINEERING

PROPOSED REVISIONS for DAC & BOS APPROVAL

Program: B.Tech Mechanical Year/semester of study: 3rd Year II Semester Academic year: 2022-2023

Course Title: MODELING ANALYSIS & DESIGN OF ROBOTIC SYSTEMS Course Code: 20ME4053

Item	CO No	Existing	Proposed Modification	Justification for the proposed modifications	PO/PSO mapping* (ex: PO1-1 or PO1-2 or PO1-3)
Course Outcome	CO1	Apply the forward and inverse dynamics for robots	Apply the anatomy of existing robotic systems and their performance specifications, end effectors, etc.	The given syllabus is at advanced level and students have not studied any fundamental level course in this area. Hence it is proposed to modify the syllabus accordingly.	PO1, PO2
	CO2	Model and simulate of motion of robots and manipulators	Identify the suitable sensors and actuators for a real time robotic system		PO1, PO2
	CO3	Kinematic modeling and analysis of mechanical and robotic systems	Apply the Denavit Hartenberg procedure to solve forward and inverse kinematics of robots.		PO1, PO2
	CO4	Implementation of the control on mechanical / robotic systems	Selection of appropriate robot control and arm configurations for specific applications		PO1, PO2
Reference Books		1. Kelly R, Santibanez V and Loria A, —Conrol of Robot Manipulators in Joint Space‖, Springer, 2005. 2. Devendra K Chaturvedi, —Modeling and Simulation of Systems using MATLAB and Simulink, CRC press, 2010.	1. Robotic engineering by Richard D. Klafter, Prentice Hall India. 2. Industrial robotics by Mikell P.Groover, Mcgraw Hill Publications 3. Kelly R, Santibanez V and Loria A, —Conrol of Robot Manipulators in Joint Space‖, Springer. 4. Devendra K Chaturvedi, —Modeling and Simulation of Systems using MATLAB and Simulink, CRC press.	Textbook are proposed as per the modified syllabus.	PO2

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Existing Syllabus	Proposed Syllabus	Reasons for Changes in Existing Syllabus
Introduction to Robot Dynamics and Kinematics: Forward Dynamics and Inverse Dynamics – Importance – Spatial description and transformations – Different types of dynamic formulation schemes – Lagrangian formulation for equation of motion for robots and manipulators. Dynamic Modeling and Simulation: Modeling of motion robots and manipulators using Newton – Euler equations – State space representation of equation of motion and system properties – Importance of Simulation and its types – Numeric Integration solvers and their role in numeric simulation - Numeric simulation of robots and manipulators using MATLAB / Simulink module. Introduction to Robot Control: Introduction – Need and types of control schemes for robots – joint space control schemes with an example – task space control schemes with an example. Kinematics and Dynamics Modeling: Kinematic modeling and analysis of mechanical and robotic systems – Forward kinematics and inverse kinematics – Jacobian and velocity analysis – Dynamic/ Kinetic modeling and analysis of mechanical and robotic systems – Forward dynamics, statics and performance analysis. Kinematics and Dynamics Controlling: System control of mechanical / robotic systems using Adams – Inverse dynamics, regulatory control and tracking control.	INTRODUCTION TO ROBOTICS: Major components of a Robot, Robotic-like devices, Classification of Robots – Classification by coordinate system and by control method. ROBOT END EFFECTORS: Introduction, End effectors, interfacing, types of End effectors, grippers and tools, Considerations in the selection and design of remote cantered devices. ROBOTIC SENSORY DEVICES: Non-Optical position sensors – Potentiometers, Synchros, inductosyn, optical position sensors – opto interrupters, Optical encoders (absolute & incremental). PROXIMITY SENSORS: Contact type, non-contact type – Reflected light, scanning Laser sensors. TOUCH & SLIP SENSORS: Touch sensors – proximity Rod & Photo detector sensors, Slip sensors– Forced oscillation slip sensor, interrupted type slip sensors, force and torque sensors. TRANSFORMATIONS AND KINEMATICS: Objectives, homogeneous coordinates, basic transformation operations, forward solution – Denavit Hartenberg procedure, Simple problems involving planar manipulators, inverse or backward solution – problems involved, techniques. INTRODUCTION TO ROBOT CONTROL: Introduction – Need and types of control schemes for robots – joint space control schemes with an example – task space control schemes with an example. ROBOT APPLICATIONS: Industrial Applications – Material Transfer, material handling, Loading and unloading, processing, spot and continuous arc welding, spray painting, grinding, Assembly and Inspection and Non-Industrial Applications.	The given syllabus is at advanced level and students have not studied any fundamental level course in this area. Hence it is proposed to modify the syllabus accordingly.

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*Note: For PO/PSO mapping the level of mapping to be considered is

Level-1: Low level of mapping of the PO statement with the CO statement

Level-2: Medium level of mapping of the PO statement with the CO statement

Level-3: High level of mapping of the PO statement with the CO statement

For your reference, please see the next page for PO & PSO statements, the key words for each statement are highlighted

A. Sri Harsha
Course Coordinator

Vijai Kumar
BOS Chairman

Dr. T. VIJAYA KUMAR
HOD-Mechanical Engineering
Koneru Lakshmaiah Education Foundation
(Deemed to be University)
Green Fields, VADDESWARAM-522 302

Y19 batch students studied the basic course and prepared this syllabus for them, but Y20 students not studied basic course for them very difficult to understand this course, hence the revision of syllabus proposed for your approval.

S. [signature]
(Dr. S.S. Rao)

20ME4053 - MODELING ANALYSIS & DESIGN OF ROBOTIC SYSTEMS

L-T-P-S	: 2-0-2-0
Credits	: 3
Contact Hours	: 4
Pre-requisites	: Nil

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Apply the anatomy of existing robotic systems and their performance specifications, end effectors, etc.	PO1, PO2	3
CO2	Identify the suitable sensors and actuators for a real time robotic system	PO1, PO2	3
CO3	Apply the Denavit Hartenberg procedure to solve forward and inverse kinematics of robots.	PO1, PO2	3
CO4	Selection of appropriate robot control and arm configurations for specific applications	PO1, PO2	3
CO5	Kinematic modeling and analysis of ABB IRB 1600 industrial robot with the help of ABB RobotStudio software.	PO3	4

CO1

INTRODUCTION TO ROBOTICS: Major components of a Robot, Robotic-like devices, Classification of Robots – Classification by coordinate system and by control method.

ROBOT END EFFECTORS: Introduction, End effectors, interfacing, types of End effectors, grippers and tools, Considerations in the selection and design of remote cantered devices.

CO2

ROBOTIC SENSORY DEVICES: Non-Optical position sensors – Potentiometers, Synchros, inductosyn, optical position sensors – opto interrupters, Optical encoders (absolute & incremental).

PROXIMITY SENSORS: Contact type, non-contact type – Reflected light, scanning laser sensors. TOUCH & SLIP SENSORS: Touch sensors – proximity Rod & Photo detector sensors, Slip sensors– Forced oscillation slip sensor, interrupted type slip sensors, force and torque sensors.

CO3

TRANSFORMATIONS AND KINEMATICS: Objectives, homogeneous coordinates, basic transformation operations, forward solution – Denavit Hartenberg procedure, Simple problems involving planar manipulators, inverse or backward solution – problems involved, techniques.

Dr. T. VIJAYA KUMAR
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Koneru Lakshmaiah Education Foundation
(Deemed to be University)

CO4

INTRODUCTION TO ROBOT CONTROL: Introduction – Need and types of control schemes for robots – joint space control schemes with an example – task space control schemes with an example.

ROBOT APPLICATIONS: Industrial Applications – Material Transfer, material handling, Loading and unloading, processing, spot and continuous arc welding, spray painting, grinding, Assembly and Inspection and Non-Industrial Applications.

Text books:

1. Robotic engineering by Richard D. Klafter, Prentice Hall India.
2. Industrial robotics by Mikell P.Groover, Mcgraw Hill Publications
3. Kelly R, Santibanez V and Loria A, –Conrol of Robot Manipulators in Joint Spacel, Springer.
4. Devendra K Chaturvedi, –Modeling and Simulation of Systems using MATLAB and Simulink, CRC press.

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Annexure-3(h)

21ME2209-Numerical methods for Mechanical Engineers

Program:B.TECH Year/semester of study:II/II A.Y. 2022-2023

Item	CO No	Existing	Proposed Modification	Justification for the proposed modifications	PO/PSO mapping* (ex:PO1-1 or PO1-2 or PO1-3)
Course Outcome	CO1	Apply elementary programming concepts, and solving basic mathematical expressions using MATLAB	Apply elementary programming concepts in solving basic mathematical expressions using MATLAB	Apply Programming concepts in solving mathematical expressions	PO1-Level3
	CO2	solving linear algebra, probability and statistics for engineering problems using MATLAB	Apply concepts of linear algebra, probability, and statistics for solving engineering problems using MATLAB	Apply the concepts of linear algebra, probability for solving engineering problems	PO1-Level3
	CO3	Solve a system through linear and nonlinear equations, and ordinary differential equations in Mechanical Engineering	Solve Mechanical Engineering systems that involve linear and nonlinear equations, and ordinary differential equations	Solve the mechanical engineering systems	PO1-Level3
	CO4	Select an appropriate numerical approach for solving engineering problems	Select an appropriate numerical approach for solving engineering problems	No change	PO1-Level3
	CO5	Ability to select bench marks to confirm the computational approach	Solve mechanical engineering system problems by applying various numerical methods	Practice the experiments to solve mechanical engineering systems	PO1-Level3
Reference Books		No change	No Change		

Existing Syllabus	Proposed Syllabus	Reasons for Changes in Existing Syllabus
No Change	No Change	

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Annexure-4

New Elective Courses for M.Tech-Machine Design

22ME5114- MECHATRONICS

L-T-P: 3-0-0-0 **Credits: 4** **Pre-requisite: NIL**

CO#	Course Outcome	PO/PSO	BTL
CO1	Apply the principles of mechatronics and automation for the development of productive and efficient manufacturing systems.	PO2	3
CO2	Apply the principles of Data conversion to Industrial mechanical and electrical drives, Microprocessors and micro controllers.	PO2	3
CO3	Analyze Hydraulic systems and design hydraulic circuits	PO2	4
CO4	Analyze the Pneumatic systems and understand PID controllers, CNC machines and Industrial Robotics.	PO4	4

Syllabus:

Module I: Introduction: Mechatronics in manufacturing, Products, and design. Comparison between Traditional and Mechatronics approach. **Module II:** Review of fundamentals of electronics. Data conversion devices, sensors, microsensors, transducers, signal processing devices, relays, contactors and timers. Microprocessors controllers and PLCs. **Module III:** Drives: stepper motors, servo drives. Ball screws, linear motion bearings, cams, systems controlled by camshafts, electronic cams, indexing mechanisms, tool magazines, transfer systems. **Module IV:** Hydraulic systems: flow, pressure and direction control valves, actuators, and supporting elements, hydraulic power packs, pumps. Design of hydraulic circuits. Pneumatics: production, distribution and conditioning of compressed air, system components and graphic representations, design of systems. Description

Module V: Description of PID controllers. CNC machines and part programming. Industrial Robotics.

Text books:

1. HMT ltd. Mechatronics, Tata Mcgraw-Hill, New Delhi, 1988.
2. G.W. Kurtz, J.K. Schueller, P.W. Claar . II, Machine design for mobile and industrial applications, SAE, 1994.
3. T.O. Boucher, Computer automation in manufacturing - an Introduction, Chappman and Hall, 1996.
4. R. Iserman, Mechatronic Systems: Fundamentals, Springer, 1st Edition, 2005
5. Musa Jouaneh, Fundamentals of Mechatronics, 1st Edition, Cengage Learning, 2012.

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22ME51J4-MODELING AND SIMULATION OF MECHATRONIC SYSTEMS

L-T-P: 2-0-2-0 **Credits: 4** **Pre-requisite: NIL**

CO#	Course Outcome	PO/PSO	BTL
CO1	Build mathematical models of mechatronic systems such as mechanical, electrical, fluid, thermal.	PO1, PO2	3
CO2	Build mathematical models of electro-mechanical systems and representation of systems using transfer function.	PO1, PO2	3
CO3	Represent the systems using state space approach and system identification techniques to synthesize system models	PO1, PO4	3
CO4	Evaluate time response and frequency of systems.	PO1, PO4	3
CO5	Modeling and Simulation of Mechatronic Systems using MATALAB/Simulink	PO1, PO2, PO3, PO4	4

Syllabus:

Physical Modelling: Mechanical and electrical systems, physical laws, continuity equations, compatibility equations, system engineering concept, system modelling with structured analysis, modelling paradigms for mechatronic system, block diagrams, mathematical models, systems of differential-algebraic equations, response analysis of electrical systems, thermal systems, fluid systems, mechanical rotational system, electrical-mechanical coupling.

Simulation Techniques: Solution of model equations and their interpretation, zeroth, first and second order system, solution of 2nd order electro-mechanical equation by finite element method, transfer function and frequency response, non-parametric methods, transient, correlation, frequency, Fourier and spectra analysis, design of identification experiments, choice of model structure, scaling, numeric methods, validation, methods of lumped element simulation, modelling of sensors and actuators, hardware in the loop simulation (HIL), rapid controller prototyping, coupling of simulation tools, simulation of systems in software (MATLAB, LabVIEW) environment.

Modelling and Simulation of Practical Problems:

1. Pure mechanical models
2. Models for electromagnetic actuators including the electrical drivers
3. Models for DC-engines with different closed loop controllers using operational amplifiers
4. Models for transistor amplifiers
5. Models for vehicle system

Text Books:

1. L. Ljung, T. Glad, "Modeling of Dynamical Systems", Prentice Hall Inc. (1994).
2. D.C. Karnopp, D.L. Margolis and R.C. Rosenberg, "System Dynamics: A Unified Approach", 2nd Edition, Wiley-Interscience (1990).
3. G. Gordon, "System Simulation", 2nd Edition, PHI Learning (2009).
4. V. Giurgiutiu and S. E. Lyshevski, "Micromechatronics, Modeling, Analysis, and Design with MATLAB", 2nd Edition, CRC Press (2009).

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22ME52K4-ROBOTICS: ADVANCED CONCEPTS AND ANALYSIS

L-T-P: 3-0-0-0 **Credits: 4** **Pre-requisite: NIL**

CO#	Course Outcome	PO/PSO	BTL
CO1	Apply the concept of robot configuration and transformations for robotic systems	PO1	3
CO2	Apply the kinematics and velocity analysis of a manipulator.	PO1, PO2	3
CO3	Apply the dynamics and planning & control of a manipulator	PO1, PO2	3
CO4	Identify and employ the suitable robots in industrial and medical applications	PO1	3

Syllabus:

Introduction to robotics: brief history, types, classification and usage and the science and technology of robots. **Kinematics of robot:** direct and inverse kinematics problems and workspace, inverse kinematics solution for the general 6R manipulator, redundant and over-constrained manipulators. **Velocity and static analysis of manipulators:** Linear and angular velocity, Jacobian of manipulators, singularity, static analysis. **Dynamics of manipulators:** formulation of equations of motion, recursive dynamics, and generation of symbolic equations of motion by a computer simulations of robots using software and commercially available packages. **Planning and control:** Trajectory planning, position control, force control, hybrid control Industrial and medical robotics: application in manufacturing processes, e.g. casting, welding, painting, machining, heat treatment and nuclear power stations, etc; medical robots: image guided surgical robots, radiotherapy, cancer treatment, etc; **Advanced topics in robotics:** Modelling and control of flexible manipulators, wheeled mobile robots, bipeds, etc. Future of robotics.

Reference Books

1. M. P. Groover, M. Weiss, R. N. Nagel and N. G. Odrey, "Industrial Robotics-Technology, Programming and Applications", McGraw-Hill Book and Company (1986).
2. S. K. Saha, "Introduction to Robotics", Tata McGraw-Hill Publishing Company Ltd. (2008).
3. S. B. Niku, "Introduction to Robotics–Analysis Systems, Applications", Pearson Education (2001).
4. . A. Ghosal, Robotics: "Fundamental Concepts and Analysis", Oxford University Press (2008).
5. Pires, "Industrial Robot Programming–Building Application for the Factories of the Future", Springer (2007).
6. Peters, "Image Guided Interventions – Technology and Applications", Springer (2008).
7. K. S. Fu, R. C. Gonzalez and C.S.G. Lee, "ROBOTICS: Control, Sensing, Vision and Intelligence", McGraw-Hill (1987).
8. J. J. Craig, "Introduction to Robotics: Mechanics and Control", 2nd edition, Addison-Wesley (1989).

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22ME52L4-MECHATRONICS PRODUCT DESIGN

L-T-P: 3-0-0-0 **Credits:4** **Pre-requisite: NIL**

CO#	Course Outcome	PO/PSO	BTL
CO1	Apply the concept of mechatronics for real time applications.	PO1	3
CO2	Apply suitable sensors and actuators used in a Mechatronic system	PO1	3
CO3	Apply the signal conditioning interface in a Mechatronic system and implementation of control systems	PO1	3
CO4	Apply the concept of mathematical techniques to modelling and Simulation for the Mechatronic System design perspective.	PO1	3

Syllabus:

Introduction: Integrated Design issues in Mechatronics, Mechatronics Design process, Mechatronics Key Elements, Applications in Mechatronics. **Modeling and simulation of physical systems:**Electrical systems, Mechanical systems- translational&rotational systems, fluid systems. **Sensors and Transducers:** Introduction, sensor for motion and position measurement, force, torque and tactile sensors, vibration – Acceleration sensors, sensor for flow measurement, temperature sensing devices, sensor applications. **Actuating Devices:**DC Motors, Stepper motors, fluid power Actuation, fluid power design elements, piezoelectric Actuators. **System Control – Logic Methods:** Number Systems in Mechatronics, Binary Logic, Karnaugh Map Minimization, Programmable Logic Controllers. **Signal Conditioning and Real Time Interfacing:** Elements of a Data Acquisition and Control System, Transducers and Signal Conditioning, Devices for Data Conversion, Data Conversion Process.

TEXT BOOKS:

1. DevdasShetty, Richard A.Kolk, "Mechatronics System Design", PWS Publishing Company, 1997.
2. Boltan, "Mechatronics-Electronic Control Systems in Mechanical and Electrical Engineering", 2nd Edition, Addison Wesley Longman Ltd., 1999

REFERENCE BOOK:

1. D.A Bradley, D.Dawson, N.C Burd and A.J.Loader, "Mechatronics" CRC Press, 2010.

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Annexure -5

22ME51E4-Hydrogen and Fuel Cells

L-T-P: 3-0-0-0 | Credits:3 | Pre-Reqisite:Nil

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Apply the concepts of hydrogen reactions during its production in various methods	PO1	3
CO2	Apply the properties of hydrogen to understand its storage and applications	PO1	3
CO3	Apply the knowledge of thermodynamics and kinetics to understand the working of fuel cell and its classification	PO1	3
CO4	Analyze the cost effectiveness and environmental impact of fuel cells	PO2	4

Syllabus

HYDROGEN – BASICS AND PRODUCTION TECHNIQUES: Hydrogen – physical and chemical properties, salient characteristics. Production of hydrogen – steam reforming – water electrolysis – gasification and woody biomass conversion – biological hydrogen production – photo dissociation – direct thermal or catalytic splitting of water. **HYDROGEN STORAGE AND APPLICATIONS:** Hydrogen storage options – compressed gas – liquid hydrogen – Hydride – chemical Storage – comparisons. Safety and management of hydrogen. Applications of Hydrogen. **FUEL CELLS:** History – principle - working - thermodynamics and kinetics of fuel cell process – performance evaluation of fuel cell – comparison on battery Vs fuel cell. **FUEL CELL – TYPES AND APPLICATION OF FUEL CELL AND ECONOMICS :** Types of fuel cells – AFC, PAFC, SOFC, MCFC, DMFC, PEMFC – relative merits and demerits. Fuel cell usage for domestic power systems, large scale power generation, Automobile, Space. Economic and environmental analysis on usage of Hydrogen and Fuel cell. Future trends in fuel cells.

REFERENCES

1. Viswanathan B. and Aulice Scibioh.M, Fuel Cells – Principles and Applications, Universities Press, 2006.
2. Rebecca L. and Busby, Hydrogen and Fuel Cells: A Comprehensive Guide, Penn Well Corporation, Oklahoma, 2005.
3. Bent Sorensen (Sørensen), Hydrogen and Fuel Cells: Emerging Technologies and Applications, Elsevier, UK 2005.
4. Kordesch K. and G.Simader, Fuel Cell and Their Applications, Wiley-Vch, Germany 1996.
5. Hart A.B. and G.J.Womack, Fuel Cells: Theory and Application, Prentice Hall, New York Ltd., London 1989.
6. Jeremy Rifkin, The Hydrogen Economy, Penguin Group, USA 2002. 7. Barclay F.J., Fuel Cells, Engines and Hydrogen, Wiley, 2009.

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22ME51F4-FOOD PROCESSING, PRESERVATION AND TRANSPORT

L-T-P: 3-0-0-0 Credits:3 Pre-Reqisite:Nil

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the Microbiology of Food products	PO1	2
CO2	Analyze various methods of food processing and preservation	PO2	4
CO3	Apply the concepts of food processing and understand the methodologies in packing and transporting of food products	PO1	3
CO4	Analyze various methods in food transportation and storage	PO2	4

Sylalbus

INTRODUCTION: Microbiology of Food Products, Mechanism of food spoilage critical microbial growth requirements, Design for control of micro organisms, The role of HACCP, Sanitation, Regulation and standards. **PROCESSING & PRESERVATION:** Thermodynamic properties and Transfer properties, Water content, Initial freezing temperature, Ice fraction, Transpiration of fresh fruits & vegetables, Food processing techniques for Dairy products, Poultry, Meat, Fruits & Vegetables. **FREEZING & DRYING:** Precooling, Freeze drying principles, Cold storage & freezers, Freezing drying limitations, Irradiation techniques, Cryofreezing, Numerical and analytical methods in estimating Freezing, Thawing times, Energy conservation in food industry. **COLD STORAGE DESIGN & INSTRUMENTATION , PACKAGING AND TRANSPORT:** Refrigeration systems, Insulation techniques, Control & instrumentation, Fire protection, Inspection & maintenance Refrigerated transportation, Refrigerated containers & trucks, Design features, Piping & Role of cryogenics in freezing & transport. Basic packaging materials, types of packaging, Packaging design. Packaging for different types of foods.

REFERENCES

1. Alan Rodes, Principles of Industrial Microbiology, Pregmon International Pub., 1989.
2. Ibraham Dincer, Heat Transfer in Food Cooling Applications, Tailor & Francis Pub., 1997.
3. Stanley E. Charm, Fundamentals of Food Engineering, III Edition, AVI Pub. Company Inc. 1989.
4. Clive V.I. Dellino, Cold and Chilled Storage Technology, Van Nostrand Reinhold Pub. New York, 1991.
5. Arora C.P., Refrigeration and Air conditioning II Edition, McGraw-Hill, Pub., 2000.
6. ASHRAE Handbook, Refrigeration, American Society of Heating, Refrigerating and AirConditioning Engineers, Inc. Atlanta, 1988.
7. Fellows P.J., Food processing Technology: Principle and Practices, Wood Head Publishing, 1997.

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L-T-P: 3-0-0-0 **22ME52G4-ADVANCED THERMAL STORAGE TECHNOLOGIES** Credits:3 Pre-Reqisite:Nil

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand various thermal storage systems and storage materials	PO1	2
CO2	Analyze the sensible and latent heat concepts and develop a heat storage units	PO2	4
CO3	Apply the basics of storage systems to understand the various thermal storage systems	PO1	3
CO4	Apply the principles of heat storage systems on regenerators and its applications	PO1	3

Syllabus

INTRODUCTION: Necessity of thermal storage – types-energy storage devices – comparison of energy storage technologies - seasonal thermal energy storage - storage materials. **SENSIBLE HEAT STORAGE SYSTEM:** Basic concepts and modeling of heat storage units - modeling of simple water and rock bed storage system – use of TRNSYS – pressurized water storage system for power plant applications – packed beds. **LATENT HEAT STORAGE SYSTEMS:** Modeling of phase change problems – temperature based model - enthalpy model – porous medium approach - conduction dominated phase change – convection dominated phase change. **APPLICATIONS :** Specific areas of application of energy storage – food preservation – waste heat recovery – solar energy storage – green house heating – power plant applications – drying and heating for process industries.

REFERENCES

1. Crabtree R.H., Energy Production and Storage, Wiley-VCH, 2010.
2. Huggins & Robert, Energy Storage Fundamentals, Materials and Applications, Springer, 2016.
3. Ibrahim Dincer and Mark A. Rosen, Thermal Energy Storage Systems and Applications, John Wiley & Sons 2002.
4. Lunardini V.J., Heat Transfer in Cold Climates, John Wiley and Sons 1981.
5. S.P.Sukhatme, Solar Energy:Principles of Thermal Collection and Storage, Tata McGraw-Hill, 1984.
6. Schmidt.F.W. and Willmott A.J., Thermal Storage and Regeneration, Hemisphere Publishing Corporation, 1981.

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22ME52H4-ELECTRIC VEHICLE TECHNOLOGY

L-T-P: 3-0-0-0 **Credits:3** **Pre-Reqisite:Nil**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the subsystems and components used in electric vehicles and Differentiate electric and hybrid vehicles	PO1	2
CO2	Analyze & select the suitable charging methods for electric vehicles	PO2	4
CO3	Understand the drive trains used in different configurations of electric vehicles	PO1	2
CO4	Apply design considerations for electric vehicles	PO1	3

Sylalbus

NEED FOR ELECTRIC VEHICLES: Need of electric vehicles – comparative study of diesel, petrol, and pure electric vehicles. Limitations of electric vehicles, Layout of an electric vehicle, advantage and limitations, specifications, system components, electronic control system, Classification - according to the source of power and the drive arrangement, Configuration of electric vehicles, Performance of electric vehicles. **ENERGY SOURCES AND CHARGING:** Requirements of energy sources in electric vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Charging of electric vehicles-home charging, public charging, swap station, inductive charging. Locations and type of chargers. **ELECTRIC DRIVE TRAINS:** Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Steering system for electric vehicles, Suspension for electric vehicles, Brake system for electric vehicles. **DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES:** Aerodynamic- Rolling resistance- Transmission efficiency- Vehicle mass- Electric vehicle chassis and Body design considerations- Heating and cooling systems- Controllers- Power steering- Tyre choiceWing Mirror, Aerials and Luggage racks. Case Studies: Design of a Battery Electric Vehicle (BEV).

TEXT BOOKS:

1. Ali Emadi et al., Vehicular Electric Power Systems, Marcel Dekker, Inc, 2004.
2. C.C. Chan and K.T. Chau, Modern Electric Vehicle Technology, Oxford University Press, 2001.
3. James Larminie and John Lowry, "Electric Vehicle Technology Explained " John Wiley & Sons, 2003.

REFERENCE BOOKS:

1. Ron HodKinson, "light Weight Electric/ Hybrid Vehicle Design", Butterworth Heinemann Publication,2005
2. Lino Guzzella, " Vehicle Propulsion System" Springer Publications, 2005.
3. Iqbal Husain, " Electric and Hybrid Vehicles-Design Fundamentals", CRC Press, 2003. 4. Mehrdad Ehsani, " Modern Electric, Hybrid Electric and Fuel Cell Vehicles", CRC Press, 2005

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Annexure-6

K L E F

DEPARTMENT OF MECHANICAL ENGINEERING

M.TECH IN MACHINE DESIGN-2022 ADMITTED BATCH

COURSE STRUCTURE & SYLLABUS

2022-23 admitted batch Course Structure

First Year (First Semester):

S. No.	Course Code	Course Title	Periods				Contact Hours	Credits
			L	T	P	S		
1	22ME 5117	Design Methods	4	0	0	0	4	4
2	22ME 5118	Design with Advanced materials	3	0	0	0	3	3
3	22ME 5119	Theory of Elasticity and Plasticity	3	1	0	0	4	4
4	22ME 5120	Modeling & Analysis-1 (CAD)	4	0	2	0	6	5
5		Elective-1	3	0	0	0	3	3
6		Elective-2	3	0	0	0	3	3
7	22 IE 5149	Seminar	0	0	4	0	4	2
		Total	20	1	6	0	27	24

First Year (Second Semester):

S. No.	Course Code	Course Title	Periods				Contact Hours	Credits
			L	T	P	S		
1	22ME 5221	Mechanical Vibrations	3	0	0	0	3	3
2	22ME 5222	Design for Optimization	3	1	0	0	4	4
3	22ME 5223	Advanced strength of materials	3	1	0	0	4	4
4	22ME 5224	Modeling & Analysis-2 (FEM)	4	0	2	0	6	5
5		Elective-3	3	0	0	0	3	3
6		Elective-4	3	0	0	0	3	3
7	22IE 5250	Term Paper	0	0	4	0	4	2
		Total	19	2	6	0	27	24

Second Year (Third Semester & Fourth Semester)

S.NO.	Course Code	Course Title	Periods				Contact Hours	Credits
			L	T	P	S		
1	22IE6150/22IE6250	Major Project	0	0	36	0	-	36
		Total Credits	0	0	36	0	-	36

ELECTIVE COURSES:

Elective – 1	L	T	P	S	Cr

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1	22ME 51I1	Precision and Quality Engineering	3	0	0	0	3
2	22ME 51I2	Advanced Mechanisms & Manipulator Kinematics	3	0	0	0	3
3	22ME 51I3	Concurrent Engineering	3	0	0	0	3
4	**22ME51I4**	**Mechatronics**	3	0	0	0	3
Elective – 2							
1	22ME 51J1	Design of Pressure Vessels and Plates	3	0	0	0	3
2	22ME 51J2	Tribological System Design	3	0	0	0	3
3	22ME 51J3	Product Design and Development	3	0	0	0	3
4	**22ME51J4**	**Modelling and Simulation of Mechatronic system**	2	0	2	0	3
Elective – 3							
1	22ME 52K1	Mechanics of Composite Materials	3	0	0	0	3
2	22ME 52K2	Machine Tool Design	3	0	0	0	3
3	22ME 52K3	Fracture Mechanics	3	0	0	0	3
4	**22ME52K4**	**Robotics-Advanced Concepts and analysis**	3	0	0	0	3
Elective – 4							
1	22ME 52L1	Engineering Noise & Control	3	0	0	0	3
2	22ME 52L2	Engineering Failure Analysis and prevention	3	0	0	0	3
3	22ME 52L3	Design for Manufacturing, Assembly and Environment	3	0	0	0	3
4	**22ME52L4**	**Mechatronics Product Design**	3	0	0	0	3

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K L E F

DEPARTMENT OF MECHANICAL ENGINEERING

M.TECH IN THERMAL ENGINEERING-2022 ADMITTED BATCH

COURSE STRUCTURE & SYLLABUS

2022-23 admitted batch Course Structure

First Year (First Semester):

S. No.	Course Code	Course Title	Periods				Contact Hours	Credits
			L	T	P	S		
1	22ME 5109	Numerical Methods in Thermal Engineering	3	0	2	0	5	4
2	22ME 5110	Advanced Thermodynamics	3	1	0	0	4	4
3	22ME 5111	Design of Thermal Systems	3	1	0	0	4	4
4	22ME 5112	Advanced Heat and Mass Transfer	3	1	0	0	4	4
5		Elective – 1	3	0	0	0	3	3
6		Elective - 2	3	0	0	0	3	3
7	22 IE 5149	Seminar	0	0	4	0	4	2
		Total	**18**	**4**	**4**	**0**	**26**	**24**

First Year (Second Semester):

S. No.	Course Code	Course Title	Periods				Contact Hours	Credits
			L	T	P	S		
1	22ME 5213	Incompressible and Compressible Flows	3	1	0	0	4	4
2	22ME 5214	Computational Fluid Dynamics	3	0	2	0	5	4
3	22ME5215	Refrigeration and Cryogenics	3	1	0	0	4	4
4	22ME 5216	Measurements in Thermal Engineering	3	1	0	0	4	4
5		Elective – 3	3	0	0	0	3	3
6		Elective - 4	3	0	0	0	3	3
7	22 IE 5250	Term Paper	0	0	4	0	4	2
		Total	**18**	**3**	**6**	**0**	**27**	**24**

Second Year (Third Semester & Fourth Semester)

S.NO.	Course Code	Course Title	Periods				Contact Hours	Credits
			L	T	P	S		
1	22IE6150/22IE6250	Major Project	0	0	36	0	-	36
		Total Credits	0	0	36	0	-	36

ELECTIVE COURSES:

		Elective – 1	L	T	P	S	Cr
1	22ME 51E1	Heat Exchanger Design	3	0	0	0	3
2	22ME 51E2	Convection and Two-Phase Flow	3	0	0	0	3
3	22ME 51E3	Compact Heat Exchangers	3	0	0	0	3
4	22ME51E4	Hydrogen and Fuel cell Technology	3	0	0	0	3
		Elective – 2					

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1	22ME 51F1	Engine Performance and Emission Control	3	0	0	0	3
2	22ME 51F2	Thermal management of electric and electronic systems	3	0	0	0	3
3	22ME 51F3	Alternative Fuels	3	0	0	0	3
4	**22ME51F4**	**Food Processing Preservation and Transport**	3	0	0	0	3
Elective – 3							
1	22ME 52G1	Principles of Turbo-machinery	3	0	0	0	3
2	22ME 52G2	Gas Turbine Engineering	3	0	0	0	3
3	22ME 52G3	Turbo-Compressors	3	0	0	0	3
4	**22ME52G4**	**Advanced Thermal Storage Technologies**	3	0	0	0	3
Elective – 4							
1	22ME 52H1	Energy Conservation, Management & Audit	3	0	0	0	3
2	22ME 52H2	Renewable Energy Technology	3	0	0	0	3
3	22ME 52H3	Solar Energy and Wind Energy	3	0	0	0	3
4	**22ME52H4**	**Electric Vehicle Technology**	3	0	0	0	3

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Annexure-7

K L E F

Department of Mechanical Engineering

Proposed curriculum(draft) for M.Tech – PLM

2023-24 admitted batch

First Year (First Semester):

S. No.	Course Code	Course Title	Periods			Contact Hours	Credits
			L	T	P		
1		Fundamentals of PLM	3	0	2	5	4
2		New Product Design	3	0	0	3	3
3		Programming & Data Management	3	0	4	7	5
4		CAD & CAE	4	0	2	6	5
5		Elective-1	3	0	0	3	3
6		Elective-2	3	0	0	3	3
7		Seminar	0	0	4	4	2
		Total	**19**	**0**	**8**	**31**	**25**

First Year (Second Semester):

S. No.	Course Code	Course Title	Periods			Contact Hours	Credits
			L	T	P		
1		Project Management	3	0	0	3	3
2		Web and Networking Technologies	3	1	2	5	4
3		PLM: Advanced Concepts	3	0	2	5	4
4		CAM	4	0	2	6	5
5		Elective-3	3	0	0	3	3
6		Elective-4	3	0	0	3	3
7		Term Paper	0	0	4	4	2
		Total	**19**	**2**	**6**	**27**	**24**

Second Year (Third Semester & Fourth Semester)

S.NO.	Course Code	Course Title	Periods			Contact Hours	Credits
			L	T	P		
1.		Major Project	0	0	72	-	36
		Total Credits	0	0	72	-	**36**

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ELECTIVE COURSES:

Elective – 1						
1		Design for Manufacturing, Assembly and Environment	3	0	0	3
2		Mechatronics & Robotics	3	0	0	3
3		Mechanics of Composite Materials	3	0	0	3
Elective – 2						
1		Enterprise Resources Planning	3	0	0	3
2		Reliability and Life Testing	3	0	0	3
3		Customization of PLM software	3	0	0	3
Elective – 3						
1		Precision and Quality Engineering	3	0	0	3
2		Lean Manufacturing	3	0	0	3
3		Supply Chain Management	3	0	0	3
Elective –4						
1		Digital Manufacturing	3	0	0	3
2		Materials and Process Selection for Design	3	0	0	3
3		Composites: Design & Manufacturing	3	0	0	3

HOD-ME

DEAN ACADEMICS

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Fundamentals of PLM

Credits: 4

L-T-P-S: 3-0-2-0

Mapping of Course Outcomes with Program Outcomes Table:

CO No.	Course Outcome	Mapped PO	BTL
CO1	To understand the latest material on PLM and its impact on the organization	PO1, PO2	2
CO2	To provide an overview of the current thinking on the principles, strategies, practices, and applications of Product Lifecycle Management	PO1, PO2	2
CO3	To provide conceptual underpinnings of PLM, along with the newest industry views on PLM applications	PO1, PO2	2
CO4	To present frameworks which provide economic justifications for PLM projects and explain the pitfalls of a piecemeal approach to PLM	PO1, PO2	2
CO5	To study PLM software installation procedures, their architectures and implementation procedures	PO1, PO2	3

Syllabus:

Introduction: Background, Overview, Need, Benefits, and Concept of Product Life Cycle, Components / Elements of PLM, Emergence of PLM, Significance of PLM, Customer Involvement.

Product life cycle environment: Product Data and Product Workflow, The Link between Product Data and Product Workflow, Key Management Issues around Product Data and Product Workflow, Company's PLM vision, The PLM Strategy, Principles for PLM strategy, Preparing for the PLM strategy, Developing a PLM strategy, Strategy identification and selection, Change Management for PLM.

Components of PLM: Different phases of product lifecycle and corresponding technologies, Product development processes and methodologies, Foundation technologies and standards (e.g. visualization, collaboration and enterprise application integration), Information authoring tools (e.g., MCAD, ECAD, and technical publishing), Core functions (e.g., data vaults, document and content management, workflow and program management), Functional applications. (e.g., configuration management) Product organizational structure, Human resources in product lifecycle, Methods, techniques, Practices, Methodologies, Processes, System components in lifecycle, slicing and dicing the systems, Interfaces, Information, Standards, Vendors of PLM Systems and Components, Examples of PLM in use.

Introduction, Installation & maintenance of following software: Oracle / SQL Server / DB2, PLM Server, CAD Software, MS Office, Rich client, Web client, Application server, Software/ Hardware/ Network issues resolutions.

Product Development – Basic Concept, Product Development II – Phases, Product Development and Information System, Product Data Management (PDM), PDM Basic Functions, PDM Function - Product Structure Management, PDM Function - Electronic Vault Management, PDM Function - Workflow Management, PDM Function - Project Management, PDM Function - Search Management, Product Lifecycle Management (PLM) Concept, PLM Special Functions, PLM Special Functions, Industry Cases, Project Presentation

Text Books:

1. Grieves, Michael, Product Lifecycle Management, McGraw-Hill, 2006. ISBN 0071452303
2. Antti Saaksvuori, Anselmi Immonen, Product Life Cycle Management - Springer, 1st Edition (Nov.5, 2003)
3. Stark, John. Product Lifecycle Management: Paradigm for 21st Century Product Realization, Springer- Verlag, 2004. ISBN 1852338105
4. Kari Ulrich and Steven D. Eppinger, Product Design & Development, McGraw Hill International Edns, 1999.

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NEW PRODUCT DESIGN

L-T-P-S: 3-0-0-0

Credits: 3

Mapping of Course Outcomes with Program Outcomes Table:

CO No.	Course Outcome	Mapped PO	BTL
CO1	Understand the product design, product development process & methodologies	PO1, PO2	2
CO2	Integrate product development process by identifying customer needs by gathering, interpreting, organizing and establishing relative importance of the customer needs	PO1, PO2	2
CO3	highlight on complete design, justification and analysis (simulation), tool design, plan manufacturing, material and process selection, tools and software selection, testing (quality check) and servicing the product	PO1, PO2	2
CO4	promote people for selecting and solving cases from various sectors with the help of product and process systemization, identification and solving methodologies, improving product development solutions	PO1, PO2	2

Syllabus:

Introduction: Types of design, importance of design, design considerations, product life cycle, technology life cycle, benchmarking and mass customization, stages, objectives, success factors, concurrent approach in NPD

Product Development Process & Methodologies: Integrated Product development process - Identifying Customer Needs: Gather raw data from customers, interpret raw data in terms of customer needs, organize the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and the process, Conceive – Specification, Concept design: the activities of concept generation, Concept Selection: Overview of methodology, concept screening, and concept scoring, Design - Detailed design, Validation and analysis (simulation), Tool design, Realize - Plan manufacturing: Factors influencing material and process selection, approaches, tools and software used in selection, Manufacture, Build/Assemble, Test (quality check), Service - Sell and Deliver, Use, Maintain and Support, Dispose.

Product Development Approaches: Bottom-up design, Top-down design, Front-loading design workflow, Design in context, Modular design. Concurrent engineering, partnership with supplier, collaborative and Internet based design, work structuring and team deployment, Product and process systemization, problem, identification and solving methodologies, improving product development solutions

Prototyping: Prototyping basics, principles of prototyping, technologies, planning for prototypes, practical examples

Cases: Select cases from automotive, aerospace, communication, etc. sectors

Text Books:

1. Dieter George E., Engineering Design, McGraw Hill Pub. Company, 2000.
2. Ulrich Karl T and Eppinger Steven D., Product design and development, McGraw Hill Pub. Company, 1995.
3. Chitale A. K. and Gupta R. C., Product Design and Manufacture, Prentice-Hall of India, New Delhi
4. Bralla, James G., Handbook of Product Design for Manufacturing, McGraw Hill Pub. 1986

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PROGRAMMING & DATA MANAGEMENT

L-T-P-S: 3-0-4-0

Credits: 5

Mapping of Course Outcomes with Program Outcomes Table:

CO No.	Course Outcome	Mapped PO	BTL
CO1	Understand the usage of soft computing tools like spreadsheets and database management software like Oracle, Visual FoxPro, MS Access, MS SQL, etc	PO3, PO4	2
CO2	Study database design concepts and practice use of various models like E-R model, Relational models	PO3, PO4	2
CO3	Learn to use SQL for data definitions and manipulation and understand the advanced DBMS concepts including Distributed databases, PDM, Client-Server and other architectures.	PO3, PO4	3
CO4	Learn data management issues like product structure, BOMs, product variants, change management, etc in PLM software.	PO3, PO4	3
CO5	Develop skills in C++ programming and related Integrated Development Environments (IDEs), Java programming and related IDEs, Spreadsheet and DBMS packages like Oracle, Visual FoxPro / MS Access, Programming in DBMS packages with SQL	PO3, PO4	3

Syllabus:

Fundamental Concepts of Database Management: Introduction to DBMS, Entity-Relationship model, Relational model, SQL concepts, Object-Based databases and XML, DBMS architectures, Distributed databases

DBMS packages: Overview/Introduction to DBMS packages like Oracle, MS Access, Visual FoxPro, SQLserver, MySQL; Spreadsheets like MS Excel

Introduction to Search: Introduction with a sample search algorithm

Introduction to PDM: Benefits and Terminology, CIM Data, PDM functions, definition and architectures of PDM systems, Engineering data, engineering workflow and PDM acquisition and implementation, Resolving Data Issues, product data interchange, present market constraints, need for collaboration, Internet and developments in client server computing, portal integration

Components of PDM: Components of a typical PDM setup - hardware and document management - creation and viewing of documents - creating parts-version - control of parts and documents.

Configuration Management: Base lines, product structure, configuration management **Generic Products And Variants**: Products configuration, comparison between sales configuration and products generic, generic product modeling in configuration modeler, use of order generator for variant creation, registering of variants in product register

Projects And Roles: creation of projects and roles - life cycle of a product- life cycle management - automating information flow - work flows - creation of workflow, Templates- life cycle - work now integration.

Change Management: Change issue, change request, change investigation, change proposal, change activity.

Deployment model: Defining deployment methodology, Performance and Scalability Network Latency etc., various standard technologies available (Akamai Technology etc.),

Study of Programming in following languages: C++ using following IDEs, Turbo C++, Dev C++, Visual C++ (Visual Studio 2008), JAVA using JDK, OOP using Java, Inheritance, inner classes, Interfaces AWT (Abstract Windowing Toolkit)/Swing: Applets, Applications and event handling Filing and printing documents, Networking with Java, Java an XML, Images and animations, talking to databases, JDBC.

Study of DBMS: ORACLE Installation and overview of Oracle, PL/SQL -. Table definition/creation and modification, using tables, insertion and modification of data, manipulating data, sorting data, displaying data from multiple tables, sub-queries, constraints, creating views, controlling user access, triggers

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Text Books:

1. Silberschatz, Korth and Sudarshan, Database System Concepts, McGraw Hill, 2002
2. Burden Rodger, PDM: Product Data Management, Resource Pub, 2003. ISBN 0970035225
3. Crnkovic, Ivica; Asklund, Ulf; & Dahlqvist, Annita Persson, Implementing and Integrating Product Data Management and Software Configuration Management, Artech House Publishers, 2003. ISBN 1580534988
4. Grieves, Michael, Product Lifecycle Management, McGraw-Hill, 2006.
5. Antti Saaksvuori, Anselmi Immonen, Product Life Cycle Management - Springer, 1st Edition (Nov.5, 2003).
6. Software documentation of Oracle, MS Access, Visual FoxPro, SQL server, MySQL, MS Excel.
7. Holzner Steven, Java 2 Programming Black Book, Dreamtech Publishers
8. Savitch, Java Programming
9. Yashwant Kanetkar, Visual C++ Programming, BPB Publications, 1998
10. Hervert Schildt, Oop with C++

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CAD & CAE

L-T-P-S: 4-0-2-0 **Credits: 5**

Mapping of Course Outcomes with Program Outcomes Table:

CO No.	Course Outcome	Mapped PO	BTL
CO1	Understand the use of computers in design process	PO3, PO4	2
CO2	Study the mathematical representation of surfaces and curves used in geometric modeling and facilities in different CAD Software	PO3, PO4	2
CO3	Study theory of solid modeling techniques and basics of graphics programming required for CAD software development	PO3, PO4	2
CO4	To study the fundamentals of strength of materials, finite element method and applications of FEM	PO3, PO4	2
CO5	To study various software's related to design, analysis, simulation, database etc., and use of this software's	PO3, PO4	3

Syllabus:

CAD – Introduction, Role of CAD, CAD system architecture, Hardware and software for CAD, Software modules, ICG, Graphics Software, Ground rules for design of GS, functions of GS, modeling and simulation, Solid modeling methods

An overview of modeling software like UG/NX, Solid Works, Autodesk Inventor, Professional, AutoCAD, PRO/E, CATIA: Capabilities, Modules, Coordinate systems, Sketching tools, solid modeling tools, surface modeling tools, expression/parameters toolbox, data exchange tools, API and customization facilities

Geometric transformations: 2D and 3D; transformations of geometric models like translation, scaling, rotation, reflection, shear; homogeneous representations, concatenated representation; Orthographic projections

CAD/CAM Data exchange and data storage: Introduction, graphics and computing standards, data exchange standards, like IGES, STEP, Model storage - Data structures - Data base considerations - Object oriented representations - Organizing data for CIM applications - Design information system

Mathematical representations of solids: Fundamentals, Solid models, Classification of methods of representations, half spaces, boundary representation, CSG, sweep representations, Octree representations, primitive instancing, cell decomposition, spatial occupancy enumeration

Mathematical representations of curves and surfaces: Curve representation, parametric representation of analytic and synthetic curves; Surface models, Surface representations, parametric representation of analytic andsynthetic surfaces

Assembly modeling: Representation, mating conditions, representation schemes, generation of assembling sequences.

Visualization, Multi CAD system (JT etc.), how to manage non-geometric data for eg. Visualization data, light weight representations techniques such as tessalation / voxalization their motivation, how visual representation can be obtained from tessellated, voxelized data, reverse engineering, evolution. AI approaches and applications in CAD, Knowledge Based Engineering, OpenGL, Introduction to Advanced visualization topics in CAD like Modern representation schemes like FBM, PM, Feature recognition, Design by features, Tolerance modeling, System customization and design automation, Open Source CAD like Open CASCADE.

CAD: Study of at least one CAD software in each of the following category, High-End CAD like UG/NX, CATIA, Pro/E. Middle-range CAD like Solid Edge, AIP, Solid Edge Low-end CAD like AutoCAD, Turbo CAD, AutoCAD LT.

Assembly modeling (for any 2 assemblies or sub-assemblies) using top down and bottom-up approaches inclusive of sketching, parts modeling (using solid and surface modeling/styling toolboxes), drafting (parts and assemblies)

Part families and design table creation using spreadsheet interface

CAD File/data exchange amongst the various CAD software and software for CMM, CAE, CNC, CAM

Customization/Program development for parts modeling and drafting using API and other development

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tools

FEA: Using any FEA software packages solve 2 problems each on structural mechanics and heat transfer, Introduction to nonlinear analysis.

Interface: Data Transfer between CAD and FEA packages, Geometry clean up

Text Books:

1. Chris McMahon and Jimmie Browne, CAD/CAM – Principle Practice and Manufacturing Management, Addision Wesley England, Second Edition, 2000.
2. Ibrahim Zeid, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
3. Dieter George, Engineering Design – A materials and processing approach, McGraw Hill Publishers, 2000
4. Ibrahim Zeid, Matering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
5. Rogers, D.F. and Adams, A., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
6. P.Radhakrishnan, S.Subramanayan and V.Raju, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
7. Groover M.P. and Zimmers E. W., CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
8. Dr. Sadhu Singh, Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition, 2000.
9. Software Documentation, tutorials, manuals of following software namely UG/NX, Solid Works, CATIA, Autodesk Inventor Professional, AutoCAD, Open CASCADE, ANSYS Design modeller, Pro/E

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PROJECT MANAGEMENT

L-T-P-S: 3-0-0-0 **Credits: 3**

Mapping of Course Outcomes with Program Outcomes Table:

CO No.	Course Outcome	Mapped PO	BTL
CO1	Inculcate the knowledge that is required to implement various projects	PO5	2
CO2	Develop the vision for identification and formulation of the projects	PO5	2
CO3	Understand various tools and techniques which are essential for smoother execution of projects	PO5	2
CO4	Impart the knowledge that can be applied to optimize time and resources in project implementation	PO5	2

Syllabus:

Introduction to PM: Projects in Contemporary Organization, Project Life Cycle.

Project Initiation: Strategic Management, Project Selection & Evaluation, Selection Criteria & Models, Risk Management, Portfolio Process, Project Proposals, Project manager: Demands on Project manager, Selecting the Project Manager, Multicultural Communication, Project Organization: Organizational Concepts in PM, Selecting an Organizational Form, Project Planning: Systems integration, WBS & Responsibility Charts, Interface Coordination, Conflict and Negotiation in PM: Nature of Negotiation, Conflict and Project Life Cycle.

Project Implementation: Budgeting and Cost Estimation: Estimating Project Budgets, Improving Cost Estimation Process, Scheduling: Background, Network Techniques: PERT & CPM, Risk Analysis & Crystal Ball Simulation, Resource Allocation: CPM & Crashing a Project, Resource Allocation, Resource Loading & Levelling, Constrained Resource Scheduling, Multi-project Scheduling & Resource Allocation, Goldratt's Critical Chain, Monitoring & Information System, Planning-Monitoring-Controlling.

Information Needs & Reporting Process, Earned Value Analysis, Computerized PMIS, Project Control: Need for Project Control, Three Types of Control Processes, Design of Control Systems, Control of Creative Activities, Control of Change & Scope, Creep.

Project Termination: Project Auditing: System Goals & Project Audit, Audit Report, Project Audit Life Cycle, Project Termination, Varieties of Project Termination, Termination Process, Final Report, A Project History.

Text Books

1. P. Gopalakrishnan and V. E. Rama Moorthy, Project Management, Macmillan India Ltd., New Delhi, 1993.
2. Prasanna Chandra, Projects: Preparation, Appraisal, Budgeting and Implementation, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1980.
3. B. B. Goel, Project Management: Principles and Techniques, Deep & Deep Publications, New Delhi, 1986.
4. UNIDO Series on Project Management

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WEB AND NETWORKING TECHNOLOGIES

L-T-P-S: 3-1-2-0 **Credits: 5**

Mapping of Course Outcomes with Program Outcomes Table:

CO No.	Course Outcome	Mapped PO	BTL
CO1	Study web engineering skills	PO3, PO4	2
CO2	Develop skills in networking related issues and programming and software Learn XML, HTML	PO3, PO4	2
CO3	Understand the concept of J2EE technologies	PO3, PO4	2
CO4	Understand the concept of Distributed Computing, Hibernate and JSF	PO3, PO4	2
CO5	Apply the networking concepts to solve the problems	PO3, PO4	3

Web: History of Web application, W3C, Introduction to various web building technologies.
Mark up languages: Use of markup languages in building web applications, Hypertext Markup language (HTML), (Extensible mark-up Language) XML,
XML Parsers: What is parsing, Types of parsers, benefits and limitations of each parser.
RMI and networking: Introduction to Remote Method Invocation (RMI), Importance of RMI in web applications.
J2EE technologies:
JSP- What is JSP, JSP architecture, Session in JSP, Cookies and use of cookies. Servlet- Introduction to Servlet technology, web container, Methods of Servlet, Lifecycle of a servlet, advantages of servlet, HTTP session listener and filters in servlet.
EJB3- Introduction to Application server, Features of enterprise beans, benefits of EJB, Annotations, Introduction to POJO, stateless and stateful session beans.
Ajax- Introduction to framework, rule of ajax in enhancing user experience, ajax examples.
Distributed Computing Concepts of Client-Server Architecture (2-Tier, 4-Tier, n-Tier), Design aspects, Technologies (.NET, J2EE)
Security: Computer network security, data security, issues, techniques involved, known practices, multisiteconfigurations, issues,
Introduction to Hibernate and JSF
Text Books:

1. David Hunter et al, 'Beginning XML'
2. XML - O'Reilly Media
3. Jennifer Niederst, Learning Web Design 2nd Edition
4. Elizabeth Castro, HTML for the World Wide Web
5. Rod Johnson, Expert One-on-One J2EE Design and Development

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PLM: ADVANCED CONCEPTS

L-T-P-S: 3-0-2-0 **Credits: 4**

Mapping of Course Outcomes with Program Outcomes Table:

CO No.	Course Outcome	Mapped PO	BTL
CO1	Understand about global change management, Legacy System Integration & data transfer	PO1, PO2	2
CO2	Understand about product architecture, and CAD BOM alignment	PO1, PO2	2
CO3	Understand about workflow, product structuring visualization of data, architectures of PLM	PO1, PO2	2
CO4	Understand about Integration of PLM systems with other systems	PO1, PO2	2
CO5	Apply PLM techniques for the real world examples	PO1, PO2	3

Syllabus:

Global Multi-site, Global Change Management System (GTS), Legacy System Integration, Legacy DataTransfer, Security in PLM (SSO/SSL etc),

Product master management (managing the deployment of the finished design into the production environment), product architecture (Functional architecture, Physical architecture etc), understanding business object, CAD- BOM alignment, security services, PLM localization, Business modeling, classification structure, PLM System Architecture (2tier/3tier/4tier etc) Managing Changes and Workflows, Classifying Data, Managing Documents, Reports, Requirements, and Schedules, Sharing Data, Managing Product Structures, Managing Manufacturing Data, Managing Mechatronics Data, Visualizing Products, Managing CAE Data, Repeatable Digital Validation, Managing Quality Data, Managing Maintenance, Repair, and Overhaul Data.

Product Data: Data objects to represent product data, such as parts, assemblies, processes, product changes, requirements, and specifications, Simple parts (with JT /with CAD /with CAD+JT/ with CAD + drawing / with CAD + JT + drawing + other documents), Simple assembly, multilevel assembly, Hybrid assembly, concurrencyin data transfer (replica transfer/delta transfer/re-export), collision.

Concepts of Product Structure management such as Configurations, Multi CAD Integrations, issues involved, data management of heterogeneous CAD systems, management of product data interfaces, GD&T, annotations,manufacturing notes, Integration of CAM with PLM.

Text Books:

1. Grieves, Michael, Product Lifecycle Management, McGraw-Hill, 2006. ISBN 0071452303
2. Antti Saaksvuori, Anselmi Immonen, Product Life Cycle Management - Springer, 1st Edition(Nov.5, 2003)
3. Stark, John. Product Lifecycle Management: Paradigm for 21st Century Product Realization,Springer-Verlag, 2004. ISBN 1852338105
4. Kari Ulrich and Steven D. Eppinger, Product Design & Development, McGraw Hill InternationalEdns, 1999.

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COMPUTER AIDED MANUFACTURING

L-T-P-S: 4-0-2-0 **Credits: 5**

Mapping of Course Outcomes with Program Outcomes Table:

CO No.	Course Outcome	Mapped PO	BTL
CO1	Learn working principles of NC machines CNC control and part programming	PO1, PO2	2
CO2	Understand about material handling in CAM environment	PO1, PO2	2
CO3	Understand the concepts of general layouts that are used for automation, like production flow analysis, algorithms for material flow optimization	PO1, PO2	2
CO4	Understand the different types of rapid prototyping techniques	PO1, PO2	2
CO5	Practice programming for operating CNC Machines and develop models using 3D printing.	PO1, PO2	3

Syllabus:

NC/CNC: Scope and applications, NC in CAM, Principal types of CNC machine tools and their construction features, tooling for CNC, ISO designation for tooling, CNC operating system: FANUC, SINUMERIK, LINUMERIK, Programming for CNC machining – coordinate systems – manual part programming – computer assisted part programming – CNC part programming with CAD system.

Material handling in CAM environment – types – AGVS – AS/RS – Swarf handling and disposal of wastes –single and mixed mode assembly lines – quantitative analysis of assembly systems. **Computer Aided Production Planning and Control:** Process Planning: Variant and Generative systems, Aggregate production planning and master production schedule, MRP, MRP II, Capacity planning, Shop Floor Control

Rapid prototyping: Need for rapid prototyping, Basic principles and advantages of RP, General features and classifications of different RP techniques with examples, Introduction to three representative RP techniques: Fusion Deposition Modeling, Laminated Object Manufacturing and Stereo-lithography.

Introduction to Computer Aided Inspection: Coordinate Measuring Machine and its operations

Text Books

1. Mikell P.Groover, Automation, Production Systems and Computer Integrated Manufacturing, Secondedition, Prentice Hall of India, 2002
2. S.Kant Vajpayee, Principles of Computer Integrated Manufacturing, Prentice Hall of India, 1999David Bed worth, Computer Integrated Design and Manufacturing, TMH, 1998.
3. Ranky, Paul.G, Computer Integrated Manufacturing, Prentice Hall International, 1986

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ELECTIVES-1

DESIGN FOR MANUFACTURE, ASSEMBLY AND ENVIRONMENTS

UNIT I INTRODUCTION

General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances Geometric tolerances - Assembly limits -Datum features - Tolerance stacks.

UNIT II FACTORS INFLUENCING FORM DESIGN

Working principle, Material, Manufacture, Design- Possible solutions - Materials choice – Influence of materials on form design - form design of welded members, forgings and castings.

UNIT III COMPONENT DESIGN - MACHINING CONSIDERATION

Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws - Reduction of machined area- simplification by separation - simplification by amalgamation - Design for machinability - Design for economy - Design for clampability – Design for accessibility - Design for assembly – Product design for manual assembly - Product design for automatic assembly – Robotic assembly.

UNIT IV COMPONENT DESIGN – CASTING CONSIDERATION

Redesign of castings based on Parting line considerations - Minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification of uneconomical design - Modifying the design - group technology - Computer Applications for DFMA

UNIT V DESIGN FOR THE ENVIRONMENT

Introduction – Environmental objectives – Global issues – Regional and local issues – Basic DFE methods – Design guide lines – Example application – Lifecycle assessment – Basic method– AT&T's environmentally responsible product

assessment - Weighted sum assessment method – Lifecycle assessment method – Techniques to reduce environmental impact– Design to minimize material usage – Design for disassembly – Design for recyclability – Design for manufacture – Design for energy efficiency – Design to regulations and standards.

REFERENCES:

1. Boothroyd, G, 1980 Design for Assembly Automation and Product Design. New York, Marcel Dekker.
2. Boothroyd, G, Heartz and Nike, Product Design for Manufacture, Marcel Dekker, 1994.
3. Bralla, Design for Manufacture handbook, McGraw hill, 1999.
4. Dickson, John. R, and Corroda Poly, Engineering Design and Design for Manufacture and Structural Approach, Field Stone Publisher, USA, 1995.
Fixel, J. Design for the Environment McGraw Hill., 1996.

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6. Graedel T. Allen By. B, Design for the Environment Angle Wood Cliff, Prentice Hall. Reason Pub., 1996.
7. Harry Peck , Designing for manufacture, Pitman– 1973
8. Kevin Otto and Kristin Wood, Product Design. Pearson Publication, (Fourth Impression) 2009.

ELECTIVES-I

Mechatronics & Robotics

Introduction to Mechatronic system, evolution, scope and components of Mechatronics systems, Mechatronics in product and measurement system, control system and modes of control, traditional design and Mechatronic design, Introduction to Sensors, Signal conditioning and Actuators

Programmable Logic Controller: Review of logic gates, basic structure, features, input/output processing, programming, functional block diagram (FBD), ladder diagram, logic functions, latching, sequencing, jumps, internal relays, counters, shift registers, master and jump control, data handling, data movement, data comparison, arithmetic operations, code conversion, analog input and output

Microcontrollers: Comparison between microprocessor and microcontroller, organization of microcontroller system, architecture of MCS 51 controller, pin diagram of 8051, addressing modes, programming of 8051, interfacing input and output devices, interfacing D/A converters and A/D converters,

Real-Time Interfacing: Introduction, Elements of Data Acquisition and Control System, Overview of I/O Process, Installation of the I/O Card and Software, Installation of the application, Software, Examples, Over framing.

Robotics: Robot Definition, Classification of Robots, Robot System components, Functions of Robot System, Specification of Robot System, Robot Drives and Power transmission systems, Remote Centered Compliance devices.

Robotic Sensory Devices, Non optical Position sensors, Optical position sensors, Velocity sensors, Accelerometers, Proximity sensors, Touch and Slip Sensors, Force and Torque sensors – Robot vision system

Robot cell layouts – multiple Robots and machine interface, consideration in work cell design, interlocks, error detection and recovery, Robot cycle time analysis, simulation of Robot work cells.

Applications of robots in material transfer, machine loading and unloading, welding, assembly and inspection, safety, training, maintenance and quality aspects, Economics and social aspects of robotics

Text Books:

1. **W. Bolton**, Mechatronics, 3/e, Pearson Education
2. **Devdas Shetty, Richard A. Kolk**, Mechatronics System Design, Thomson
3. **Richard D.Klafter**, Thomas A.Chmielewski and Michael Negin Robotic Engineering – An Integrated Approach, Prentice Hall of India Pvt Ltd, 2002
4. **Shimon Y.Nof,** Hand Book of Robotics, John Wiley sons, 1985.

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ELECTIVES-1

Mechanics of Composite Materials

INTRODUCTION TO COMPOSITE MATERIALS:

Introduction, Classification: Polymer Matrix Composites, Metal Matrix Composites, Ceramic Matrix Composites, nature-made composites, and applications. Fibres- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibres. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites.

ELASTIC BEHAVIOR OF COMPOSITE LAMINA USING MICROMECHANICS:
Introduction, Strength of Materials Approach, Semi- Empirical Models, Elasticity Approach, Volume and Mass Fractions, Density, and Void Content, Evaluation of the Four Elastic Moduli, , Ultimate Strengths of a Unidirectional Lamina

ELASTIC BEHAVIOR OF COMPOSITE LAMINA USING MACROMECHANICS:
Introduction, Definitions: Stress, Strain, Elastic Moduli, Strain Energy, stress strain relations for general anisotropic materials, specially orthotropic materials, transversally isotropic materials, orthotropic material under plane stress and isotropic materials, relations between mathematical and engineering constants.

ELASTIC BEHAVIOR OF MULTIDIRECTIONAL LAMINATES

Basic assumptions, laminate code, strain-displacement relations, stress-strain relations of a layer within a laminate, force and moment resultants, Laminate stiffness and laminate compliance, symmetric laminates, balance laminates

FAILURE, DESIGN OF LAMINA AND LAMINATES:

Lamina Strength Failure Theories of an Angle Lamina: Maximum Stress Failure Theory Strength Ratio, Failure Envelopes, Maximum Strain Failure Theory, Tsai–Hill Failure Theory, Tsai–Wu Laminate: Introduction, Special Cases of Laminates, and Failure Criterion for a Laminate, and Design of a Laminated Composite

Text Books:

1. Engineering Mechanics of Composite Materials, (2nd edition), by Isaac and M Daniel, Oxford University Press, 2006 .
2. Analysis and performance of fibre Composites, (Second Edition), by B. D. Agarwal and L. J. Broutman, John Wiley & sons, NewYork , New York, 1990.

Reference Books:

1. Mechanics of Composite Materials, (3ed edition), by R. M. Jones, Mc Graw Hill Company, New York, 2006.
2. Analysis of Laminated Composite Structures, by L. R. Calcote, Van Nostrand Rainfold, New York, 1969.
3. Mechanics of Composite Materials, (Second Edition), by Autar K. Kaw, CRC, 2010.

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ELECTIVES-2

Enterprise Resources Planning

Introduction to ERP:

Enterprise – An Overview, Integrated Management Information, Business Modeling, Integrated Data Model

ERP and Related Technologies

Business Processing Reengineering(BPR), Data Warehousing, Data Mining, On-line Analytical Processing(OLAP), Supply Chain Management (SCM),Customer Relationship Management(CRM), MIS - Management Information System, DSS - Decision Support System, EIS - Executive Information System.

ERP Manufacturing Prospective:

MRP - Material Requirement Planning, BOM - Bill Of Material, MRP - Manufacturing Resource Planning, DRP - Distributed Requirement Planning, PDM - Product Data Management

ERP Modules

Finance, Plant Maintenance, Quality Management, Materials Management

Benefits of ERP

Reduction of Lead-Time, On-time Shipment, Reduction in Cycle Time, Improved Resource Utilization, Better Customer Satisfaction, Improved Supplier Performance, Increased Flexibility, Reduced Quality Costs, Improved Information Accuracy and Design-making Capability

ERP Implementation Lifecycle

Pre-evaluation Screening, Package Evaluation, Project Planning Phase, Gap Analysis, Reengineering, Configuration, Implementation Team Training, Testing, Going Live, End-user Training, Post-implementation (Maintenance mode)

ERP Case studies

E-Commerce to E-business E-Business structural transformation, Flexible Business Design, Customer Experience, Create the new techo enterprise, New generation e-business leaders, memo to CEO, Empower your customer, Integrate Sales and Service, Integrated Enterprise applications

E-Business Architecture

Enterprise resource planning the E-business Backbone Enterprise architecture planning, ERP usage in Real world, ERP implementation, Future of ERP applications ,memo to CEO E-

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Procurement, E-Governance, Developing the E-Business Design Introduction to ERP tools JD-Edwards-Enterprise One, Microsoft Dynamic CRm-Module

Reference Books:

1. Enterprise Resource Planning - Alexis Leon, Tata McGraw Hill.

2. Enterprise Resource Planning – Diversified by Alexis Leon, TMH.

3. Enterprise Resource Planning - Ravi Shankar & S. Jaiswal , Galgotia.

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ELECTIVES-2

Reliability and Life Testing

Reliability concepts, remaining life time, mean time between failure (MTBF), hazard function (HF), bath-shape HF, Reliability in terms of HF. Estimation of parameters and tests in these models. Reliability estimation based on failure times in various censored life tests and in tests with replacement of failed items; stress-strength reliability and its estimation.

Life distribution; reliability function, hazard rate; common life distributions- Exponential, Weibull, gamma, Pareto and lognormal distributions.

Reliability concepts and measures; components and systems; coherent systems; reliability of coherent systems; cuts and paths; modular decomposition; bounds on system reliability; structural and rehability importance of components.

Bayes estimator, for exponential, negative exponential, Weibull and normal life model. Estimation of survival function-Actuarial Estimator, Kaplan-Meier Estimator; Properties of K-M estimator;

Basic Text & Reference Books:-

Cox, D.R. and Oakes, D. (1984) Analysis of Survival Data, Chapman and Hall, New York.
Gross A.J. and Clark, V. A. (1975) Survival Distributions: Reliability Applications in the Biomedical Sciences, John Wiley and Sons.
Elandt - Johnson, R.E. Johnson N.L. (1980) Survival models and Data Analysis, John Wiley and Sons Miller, R.G (1981) Survival Analysis (Wiley)
Barlow R. E. & Proschan F. (1975) Statistical Theory of Reliability & Life testing. Holt, Rinehart & Winston Inc. Zacks, S. Reliability

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ELECTIVES-2

Customization of PLM software

Introduction to customization, need, types; introduction, Basic customization concepts, common customization tasks, software engineering concept; Software Development Life Cycle (SDLC), Requirement analysis, Rapid application Development (RAD) tools, programming languages. Customisation of World processing and spreadsheet tools

CAD modeling software customization; overview, system development and general purpose customization toolsfor any one of software like NX, CATIA, etc; Overview of CAE software (like ANSYS, Hypermesh, NASTRAN etc) customisation. OOP and C++ programming concepts

TC customization using BMIDE, ITK, Rich/thin clients; PLM s/w (TC) Architecture and POM schema; Overview of customization in Enovia/Smarteam, Windchill PLM, ARAS; Integration of TC with other software.

References:

1. McMohan; CAD/CAM/CIM; Addsion Wesley Publishiers
2. Teamcenter Documentation /Help Manuals,
3. Getting started with Customisation,
    1. Thin client customisation –Programmer's Guide
    2. Integration Toolkit Programmer's Guide
    3. Business Modeler IDE Guide,
    4. Application interface Web Service (AIWS) configuration and customization Guide.
    5. Rich Client Customisation- Programmer's Guide,
4. NX documentation for open C/C++, GRIP, Knowledge fusion
5. Software documentation for Word, Excel, Access, ANSYS, Abacus, etc

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Elective-3

Precision and Quality Engineering

CONCEPTS OF ACCURACY:

Introduction – Concept of Accuracy of Machine Tools – Spindle and Displacement Accuracies – Accuracy of numerical Control Systems – Errors due to Numerical Interpolation Displacement Measurement System and Velocity lags.

GEOMETIC DEIMENSIONING AND TOLERANCING:

Tolerance Zone Conversions – Surfaces, Features, Features of Size, Datum Features – Datum Oddly Configured and Curved Surfaces as Datum Features, Equalizing Datum's – Datum Feature of Representation – Form controls, Orientation Controls – Logical Approach to Tolerancing.

QUALITY ENGINEERING

Quality Dimensions – Quality definitions – Inspection - Quality control – Quality Assurance – Quality planning - Quality costs – Economics of quality – Quality loss function

CONTROL CHARTS

Chance and assignable causes of process variation, statistical basis of the control chart, control charts for variables- X , R and S charts, attribute control charts - p, np, c and u-Construction and application.

SPECIAL CONTROL PROCEDURES

Warning and modified control limits, control chart for individual measurements, multi-vari chart, X - chart with a linear trend, chart for moving averages and ranges, cumulative-sum and exponentially weighted moving average control charts.

STATISTICAL PROCESS CONTROL

Process stability, process capability analysis using a Histogram or probability plots and control chart. Gauge capability studies, setting specification limits.

ACCEPTANCE SAMPLING

The acceptance sampling fundamental, OC curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables, MIL-STD-105D and MIL-STD-414E & IS2500 standards.

REFERENCES:

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1. Precision Engineering in Manufacturing/Murthy R.L./New Age International (P) limited, 1996.
2. Geometric Dimensioning and Tolerancing / James D. Meadows / Marcel Dekker inc. 1995.
3. Precision Engineering/VC Venkatesh& S Izman/TMH
4. Douglas C Montgomery, Introduction to Statistical Quality Control, John Wiley, Seventh Edition, 2012.
5. Grant E.L. and Leavensworth, Statistical Quality Control, TMH, 2000.
6. IS 2500 Standard sampling plans

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Lean Manufacturing

Introduction to Lean Manufacturing: Production System and its types, Transition to Lean, Lean Thinking, Manufacturing Strategies, Benefits of Lean Manufacturing

Elements of Lean Manufacturing: Elimination of Waste, Value Stream Mapping, 5S, Kaizen Approach, Introduction to and comparative study of Toyota Production System, Total Productive Maintenance, Total Quality Management and Six Sigma, Lean Indicators and Organizational Performance

Cellular Manufacturing: Layouts, Group Technology - part families, clustering methods - Rank Order Clustering, Single-Pass Heuristic considering Capacities (Askin and Standridge), Clustering using Similarity Coefficients, Production Flow Analysis, Utility Layout

Just In Time Production System: JIT Philosophy, JIT implementation requirements, Production Smoothening – philosophy and methods, Pull system - Production Authorization, Kanban Systems, scheduling Kanban production, CONWIP system, Base Stock System, Inventory Management in JIT, Information Management in JIT

Shortening of Production Lead Times: Reduction of setup times, practical procedures for reducing setup time, Transfer Lots, Economic implications of setup time reduction, Standardization of operations, multi function workers and job rotation

Human Approach for Lean Implementation: Lean Leadership, Total Employment Involvement, Small Group Activities like Quality Circles, SMTs, etc.

Scheduling: Scheduling System Requirements, Bottleneck Scheduling, Single Machine Scheduling, Flow Shop Scheduling, Job Shop Scheduling

Text Books

1. Ronald G. Askin and Jeffrey B. Goldberg, "Design and Analysis of Lean Production Systems"
2. Chasel Aquilino, "Productions and Operations Management"
3. Yasuhiro Monden, "Toyota Production System -An integrated approach to Just in Time", Engineering and Management Press, Institute of Industrial Engineers, , Norcross Georgia
4. James P Womack, Daniel T Jones, and Daniel Roos, "The Machine that changed the World. The Story of Lean Production", Harper Perennial edition, 1991.
5. James Womack, "Lean Thinking".
6. Richard Schourberger, "Japanese Manufacturing Techniques. The Nine Hidden Lessons by simplicity".
7. Jeffrey Liker "The Toyota Way : 14 Management Principles from the World's Greatest Manufacturer: 14 Management Principles from the World's Greatest Manufacturer"

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Supply Chain Management

Logistics and Competitive Strategy: Competitive advantage – gaining competitive advantage through logistics

– mission of logistics management – supply chain and competitive performance – changing logistics environment, supply chain management and the PLM ecosystem.

Customer Service Dimension: marketing and logistics interface – customer service and customer retention – service driven logistics systems – setting customer service priorities – setting service standards.

Measuring Logistics Cost and Performance: concept of total cost analysis – principles of logistics costing – logistics and the bottom line – logistics and shareholder value – customer profitability analysis – direct product profitability – cost drivers and activity-based costing.

Benchmarking the Supply Chain: benchmarking the logistics process – mapping supply chain processes – supplier and distribution benchmarking – setting benchmarking priorities – identifying logistics performance indicators.

Managing the global pipeline: trend towards globalization in the supply chain – challenge of global logistics - organizing for global logistics.

Strategic Lead-Time Management: time based competition – concept of lead-time – logistics pipeline management – logistics value engineering – lead-time gap.

Just In Time and Quick Response Logistics – Japanese philosophy – implications for logistics – quick response logistics – vendor managed inventory – logistics information systems – logistics systems dynamics – productionstrategies for quick response.

Managing the Supply Chain: creating logistics vision – problems with conventional organizations – developing logistics organizations - logistics as a vehicle for change – need for integration – managing supply chain as a network – process integration and ECR – co-makership and logistics partnerships – supplierdevelopment.

Role of Information Systems and Technology in SCM: importance of information in an integrated SCM environment – inter organisational information systems (IOIS) – information requirements determination for a supply chain IOIS – information and technology applications of SCM.

Developing and Maintaining Supply Chain Relationships: conceptual model of alliance development – developing a trusting relationship with partners in supply chain – resolving conflicts in supply chain relationship.

Cases in SCM: Future Challenges in SCM: greening of supply chain – design for SCM – intelligent informationsystems.

Text Books

1. **Martin Christopher,** - Logistics and Supply Chain Management – Strategies for reducing cost andimproving service, Pitman Publishing, II Edition, 1998.
2. **Robert B Handfield and Ernest L Nicholas Jr.,** Introduction to Supply Chain Management, PrenticeHall, NJ, 1999.

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3. **Donald J Bowersox and David J Closs**, Logistical Management, Tata McGraw Hill, New Delhi,2000.
4. **David Taylor and David Brunt**, Manufacturing Operations and Supply Chain Management, Thomson Learning, 2001.
5. **David Simchi and Levi**, Designing and Managing the Supply Chain, McGraw Hill, 2000.
6. **J B Ayers**, Handbook of Supply Chain Management, St. Lencie Press, 2000.
7. **B S Sahay**, Supply Chain Management for Global Competitiveness, Macmillan India Ltd., New Delhi,2000.
8. **P B Scharj and TS Lansen**, Managing the Global Supply Chain, Viva Books, New Delhi, 2000.

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Elective-4

Digital Manufacturing

Introduction to Digital Manufacturing: A Brief History of Manufacturing, Digital Manufacturing Today, Digital Design, Digital Materials, Digital Fabrication, Digital Products, Technology Development, Applications Development, People and Business, The Digital Economy, Transition from Industrial Manufacturing

Process simulation and validation: Assembly and component manufacturing, process simulation and validation, Ergonomic/ human simulation, Robotic simulation and OLP

Plant design, simulation & optimisation: Station / work-cell layout design, Throughput simulation, Discrete event simulation, Optimisation of material flow and logistic

Manufacturing process simulation solution customisation: Functionality enhancements as extensions of OOTB software solution, Reports customisation, User interface customisation

Special Topics: Informatics platform for designing and deploying e-manufacturing systems, framework for integrated design of Mechatronic systems, Collaborative supplier integration for product design and development. Reconfigurable manufacturing systems design, Virtual Reality based platform for collaborative product review and customisation, Managing collaborative process planning activities through extended enterprise, rapid product development, desktop assembly factories, Information sharing in digital manufacturing based on STEP and XML

Text Books:

- Wang, Lihui; Nee, Andrew Y.C. (Eds.) Collaborative Design and Planning for Digital Manufacturing, Springer, 2009.

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MATERIALS AND PROCESS SELECTION FOR DESIGN

Syllabus:

Introduction: The families of Engineering materials, The Design process, types of design, Design tools and materials data.

Materials Selection-The basics and case studies: Introduction, the selection strategy, attribute limits and material indices, the selection procedure, computer-aided selection, the structural index, summary and conclusions, case studies

Selection of material and shape, case studies: Introduction, shape factors, Microscopic or micro-structural shape factors, limits to shape efficiency, exploring and comparing structural sections, material indices that include shape, co-selecting material and shape, summary and conclusions, case studies

Selecting candidate processes: A strategic view, selecting candidate processes, process information maps, Prima selection strategies, Prima categories: Casting, forming, machining processes.

Designing Hybrid materials and case studies: Introduction and synopsis, filling holes in material property space, hybrids of type 1, 2, 3, 4, Summary and conclusions, case studies

Information and knowledge sources for design: Introduction, Information for materials and processes, screening information, supporting information, ways of checking and estimating data, Summary and conclusions

Materials and industrial design: Introduction, the requirements pyramid, product character, using materials and processes to create product personality - Summary and conclusions.

Learning Resources:

Text Books:

1. Engineering Materials, M.F. Ashby: 4th Edition, Elsevier, 2005.
2. Materials Selection in Mechanical Design, M.F. Ashby: Butterworth Heinemann, 2005.
3. Materials Selection and Design, ASM Publication, Vol.20: ASM, 1997.
4. The Principles of Materials Selection and Design, Prentice Hall International, Pat L. Mangonon: Inc.1999.

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Composites: Design & Manufacturing

Types and forms of reinforcement and their properties. Pre-fabricated forms. Selection of matrices: physical and mechanical properties. Bonding mechanisms. Types of reinforcement distributions: uniform, gradient and surface. Factors in composite design. Structure-property relationships. Models of various materials properties of composites: density, modulus, strength,specific heat, coefficient of thermal expansion, thermal conductivity and diffusivity, electrical conductivity and dielectric constant. Isotropic and anisotropic properties.

Fabrication techniques: infiltration, casting, reaction sintering, electro-deposition, diffusion bonding, thermal and plasma spray forming, laser method, powder forming, additive processes, crystal growth and physical vapour deposition. Testing and inspection methods. Laminated Composites, Sample level lamination, case studies.

Experimental techniques, compositional analyses (introduction) and qualification of composites.

Instrumental characterization and introduction to advanced characterization techniques (XRD, XRF, ITFR, SEM, TEM, TGA etc). Non-Destructive Analyses of Composites.

TEXT BOOKS/ REFERENCES:

1. Clyne, T. W. and Withers, P. J., "An Introduction to Metal Matrix Composites", Cambridge University Press, 1993.

2. Matthews, F. L. and Rawlings, R. D., "Composite Materials: Engineering and Science", Chapman & Hall, London, 1994.

3. Suresh, S., Martensen, A., and Needleman, A., "Fundamentals of Metal Matrix Composites", Butterworth Heinemann, 1993.

4. Kainer, K.U., "Metal Matrix Composites: custom-made materials for automotive and aerospace engineering", Wiley-VCH, 2006.

5. Chawla, N. and Chawla, K. K., "Metal Matrix Composites", Springer, 2006.

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