Study & Evaluation Scheme

of

Bachelor of Technology
in
Mechanical Engineering

[Applicable for 2019-23]

Version 2019

[As per CBCS guidelines given by UGC]

BOS	BOF	BOM
06.06.2019	18.06.2019	13-07-2019 Approved vide agenda number 2.4

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Quantum University, Roorkee

Study & Evaluation Scheme Study

Summary

Name of the Faculty	Faculty of Mechanical Engineering
Name of the School	Quantum School of Technology
Name of the Department	Department of Mechanical Engineering
Program Name	Bachelor of Technology in Mechanical Engineering
Duration	4 Years
Medium	English

Evaluation Scheme

Type of Papers	**Internal Evaluation (%)**	**End Semester Evaluation (%)**	**Total (%)**
Theory	40	60	100
Practical/ Dissertations/Project Report/ Viva-Voce	40	60	100
Internal Evaluation Components (Theory Papers)			
Sessional Examination I	50 Marks		
Sessional Examination II	50 Marks		
Assignment –I	25 Marks		
Assignment-II	25 Marks		
Attendance	50 Marks		
Internal Evaluation Components (Practical Papers)			
Quiz One	25 Marks		
Quiz Two	25 Marks		
Quiz Three	25 Marks		
Lab Records/ Mini Project	75 Marks		
Attendance	50 Marks		
End Semester Evaluation (Practical Papers)			
ESE Quiz	30 Marks		
ESE Practical Examination	50 Marks		
Viva- Voce	20 Marks		

Structure of Question Paper (ESE Theory Paper)

The question paper will consist of 5 questions, one from each unit. Student has to Attempt all questions. All questions carry 20 marks each. Parts a) and b) of question Q1 to Q5 will be compulsory and each part carries 2 marks. Parts c), d) and e) of Q1 to Q5 Carry 8 marks each and the student may attempt any 2 parts.

Important Note:

1.The purpose of examination should be to assess the Course Outcomes (CO) that will ultimately lead to attainment of Programme Specific Outcomes (PSOs). A question paper must assess the following aspects of learning: Remember, Understand, Apply, Analyze, Evaluate & Create (reference to Bloom's Taxonomy). The standard of question paper will be based on mapped BL level complexity of the unit of the syllabus, which is the basis of CO attainment model adopted in the university.

2. Case Study is essential in every question paper (wherever it is being taught as a part of pedagogy) for evaluating higher-order learning. Not all the courses might have case teaching method used as pedagogy.

3. There shall be continuous evaluation of the student and there will be a provision of real time reporting on QUMS. All the assignments will evaluated through module available on ERP for time and access management of the class.

Program Structure – Bachelor of Technology in Mechanical Engineering

Introduction

Bachelor of Technology in Mechanical Engineering syllabus covers all broad areas design, thermal production industrial and the latest technological advancements. It ensures to provide students with an effective learning experience with thought-provoking teaching pedagogy. The curriculum is highly demanding and thoughtfully designed to incorporate all the latest development in the field. The curriculum of Mechanical engineering aims at creating the right mindset which ensures the creation of innovative, thoughtful, and socially aware engineers. We believe in the practical nature of the domain and focus on learning by doing it practically. Students will gain an ability to specify, fabricate, test, operate, validate and complete documentation of any basic mechanical systems or processes. Students will gain an ability to apply the acquired software's skills to design and analysis of advanced mechanical systems or processes.

Towards enhancing employability and entrepreneurial ability of the graduates the Quantum University increase the practical content in the courses wherever necessary. The total number of credits in 8 semesters program will range from 175 to 187 for all the programmes.

In order to harness regional specialties and to meet region-specific needs the Quantum University modify the content of syllabus as per the regional demands.

Curriculum (2019-23)

Quantum School of Technology

Department of Mechanical Engineering

Bachelor of Technology in Mechanical Engineering –PC:01-3-05

BREAKUP OF COURSES

Sr. No	CATEGORY	CREDITS
1	Foundation Core (FC)	40
2	Program Core (PC)	73
3	Program Electives (PE)	15
4	Open Electives (OE)	9
5	Project	14
6	Internship	5
7	Value Added Programs (VAP)	12
8	General Proficiency (GP)	7
9	Disaster Management*	2*
TOTAL NO. OF CREDITS		175
TOTAL NO. OF CREDITS (Honors)		187

*Non-CGPA Audit Course

DOMAIN-WISE BREAKUP OF CATEGORY

Domain	Foundation core	Program core	Program elective	Sub total	%age
Sciences	13	-	-	13	7.42
Humanities	5	-	-	5	2.86
Management	5	3	-	8	4.57
Engineering	17	70	15	121	69.14
Open elective				9	5.14
VAP				12	6.86
GP				7	4.00
Disaster Management*				2*	0.0
Grand Total	**40**	**73#**	**15**	**175**	**100**

#Credits of projects and internships included *Non-CGPA Audit Course

SEMESTER-WISE BREAKUP OF CREDITS

Sr. No	CATEGORY	SEM 1	SEM 2	SEM 3	SEM 4	SEM 5	SEM 6	SEM 7	SEM 8	TOTAL
1	Foundation Core	20	20		-	-	-	-	-	40
2	Program Core	-	-	20	17	15	12	9	-	73
3	Program Electives	-	-	(+3H)	(+3H)	(+3H)	3 (+3H)	6	6	15 (+12H)
4	Open Electives	-	-	-	3	3	3	-	-	9
5	Projects	-	-	2	2	2	2	2	4	14
6	Internships	-	-	1	-	2	-	2	-	5
7	VAPs	1	1	1	1	2	4	2	-	12
8	GP	1	1	1	1	1	1	1	-	7
9	Disaster Management*									2*
	TOTAL	**22**	**22**	**25**	**24**	**25**	**25**	**22**	**10**	**175**

Group B

SEMESTER 1

Course Code	Category	Course Title	L	T	P	C	Version	Course Prerequisite
MA3102	FC	Mathematics I	3	2	0	4	1.0	Nil
PS3101	FC	Human Values and Ethics	2	0	0	2	1.0	Nil
CS3101	FC	Basics of Computer and C Programming	4	0	0	4	1.1	Nil
EC3101	FC	Basic Electrical and Electronics Engineering	3	0	0	3	1.1	Nil
EG3102	FC	Professional Communication	2	0	0	2	1.0	Nil
CS3140	FC	Basics of Computer and C Programming Lab	0	0	2	1	1.0	Nil
EG3140	FC	Professional Communication Lab	0	0	2	1	1.0	Nil
EC3140	FC	Basic Electrical and Electronics Engineering Lab	0	0	2	1	1.0	Nil
ME3141	FC	Engineering Graphics	0	0	4	2	1.0	Nil
VP3101	VP	Personality Development Program	0	0	2	1	1.0	Nil
GP3101	GP	General Proficiency	0	0	0	1		Nil
		TOTAL	**14**	**2**	**12**	**22**		

Contact Hrs: 28

SEMESTER 2

Course Code	Category	Course Title	L	T	P	C	Version	Course Prerequisite
MA3202	FC	Mathematics II	3	2	0	4	1.0	MA3102
PH3101	FC	Engineering Physics	2	2	0	3	1.0	Nil
CY3205	FC	Environmental Studies	2	0	0	2	1.0	Nil
ME3102	FC	Basic Mechanical Engineering	3	0	0	3	1.0	Nil
CS3207	FC	Advance Computer Programming & Software	4	0	0	4	1.0	Nil
PH3140	FC	Engineering Physics Lab	0	0	2	1	1.0	Nil
CS3245	FC	Advance Computer Programming & Software Lab	0	0	2	1	1.0	Nil
ME3140	FC	Workshop Practice	0	0	3	2	1.0	Nil
VP3201	VP	Communication & Soft Skills – II	0	0	2	1	1.0	Nil
CE3101		Disaster Management*	2	0	0	2*	1.0	Nil
GP3201	GP	General Proficiency	0	0	0	1		Nil
		TOTAL	**16**	**4**	**9**	**22**		

*Non-CGPA Audit Course

Contact Hours: 29

SEMESTER 3

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
ME3308	PC	Strength of Materials	2	2	0	3	1.0	Nil
ME3302	PC	Materials Science	2	0	0	2	1.0	Nil
ME3306	PC	Thermal Engineering	3	2	0	4	1.0	Nil
ME3304	PC	Fluid Mechanics and Machines	3	2	0	4	1.0	Nil
ME3307	PC	Computer aided Machine Drawing	1	0	3	3	1.0	Nil
ME3344	PC	Strength of Material Lab	0	0	2	1	1.0	Nil
ME3341	PC	Material Science Lab	0	0	2	1	1.0	Nil
ME3342	PC	Fluid Mechanics and Machines Lab	0	0	2	1	1.0	Nil
ME3343	PC	Thermal Engineering Lab	0	0	2	1	1.0	Nil
ME3345	PT	Project Lab I	0	0	4	2	--	--
VP3301	VP	Value added Program III	0	0	2	1	--	--
ME3371	FW	Internship Presentation	1	0	0	1	--	--
GP3301	GP	General Proficiency	0	0	0	1	--	--
		TOTAL	**12**	**6**	**17**	**25**		

Contact Hrs: 35

SEMESTER 4

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
ME3404	PC	Heat Transfer	2	2	0	3	1.0	ME3306
ME3402	PC	Theory of Machines	3	2	0	4	1.0	Nil
ME3403	PC	Production Technology	3	0	0	3	1.0	Nil
EE3404	PC	Electrical Machines	3	0	0	3	1.0	Nil
--	OE	Open Elective I	3	0	0	3	--	--
EE3443	PC	Electrical Machines Lab	0	0	2	1	1.0	Nil
ME3443	PC	Heat Transfer Lab	0	0	2	1	1.0	Nil
ME3441	PC	Theory of Machines Lab	0	0	2	1	1.0	Nil
ME3442	PC	Production Technology Lab	0	0	2	1	1.0	Nil
ME3445	PT	Project Lab II	0	0	4	2	--	--
VP3401	VP	Employability skill –I	0	0	2	1	--	--
GP3401	GP	General Proficiency	0	0	0	1	--	--
		TOTAL	**14**	**4**	**14**	**24**		
All students are required to attend 04 to 06 weeks Industrial Training after 4th semester. Performance of this training will be evaluated and awarded in 5th semester								

Contact Hrs: 32

Open Elective I

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
CE3011	OE	Carbon Emission & Control	3	0	0	3	1.0	Nil
CS3021	OE	Mining and Analysis of Big data	3	0	0	3	1.0	Nil
AG3011	OE	Ornamental Horticulture	3	0	0	3	1.0	Nil
BB3011	OE	Entrepreneurial Environment in India	3	0	0	3	1.0	Nil
JM3011	OE	Media Concept and Process (Print and Electronic)	3	0	0	3	1.0	Nil
HM3011	OE	Indian Cuisine	3	0	0	3	1.0	Nil
MB3011	OE	SAP 1	3	0	0	3	1.0	Nil
EG3011	OE	French Beginner A1	3	0	0	3	1.0	Nil
MT3011	OE	Elementary Robotics	0	0	5	3	1.0	Nil

SEMESTER 5

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
ME3501	PC	Machine Design I	3	2	0	4	1.0	ME3308/ME3301
ME3505	PC	Refrigeration and Air-Conditioning	2	2	0	3	1.0	ME3306
ME3503	PC	Operation Research	2	2	0	3	1.0	Nil
ME3504	PC	Vehicle Technology	2	2	0	3	1.0	Nil
--	OE	Open Elective II	3	0	0	3	--	--
ME3542	PC	Refrigeration and Air-conditioning Lab	0	0	2	1	1.0	Nil
ME3541	PC	Vehicle Technology Lab	0	0	2	1	1.0	Nil
ME3545	PT	Project Lab III	0	0	4	2	--	--
VP3501	VP	Employability skill –II	2	0	0	2	--	--
ME3571	FW	Internship Presentation II	2	0	0	2	--	--
GP3501	GP	General Proficiency	0	0	0	1	--	--
		TOTAL	**16**	**8**	**8**	**25**		

Contact Hrs: 32

Open Elective II

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
CE3013	OE	Environment Pollution and Waste Management	3	0	0	3	1.0	Nil
CS3023	OE	Big Data Analytics: HADOOP Framework	3	0	0	3	1.0	Nil
AG3013	OE	Organic farming	3	0	0	3	1.0	Nil
BB3013	OE	Establishing a New Business	3	0	0	3	1.0	Nil
JM3013	OE	Photo Journalism	3	0	0	3	1.0	Nil
HM3013	OE	Chinese Cuisine	3	0	0	3	1.0	Nil
MB3013	OE	SAP 3	3	0	0	3	1.0	Nil
EG3013	OE	French Intermediate B1	3	0	0	3	1.0	Nil
EG3002	OE	Report Writing	3	0	0	3	1.0	Nil
MT3013	OE	Introduction to Automation	3	0	0	3	1.0	Nil

SEMESTER 6

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
ME3601	PC	Machine Design II	3	2	0	4	1.0	ME3501
ME3603	PC	Measurement and Metrology	3	0	0	3	1.0	Nil
MT3603	PC	Mechatronics	3	0	0	3	1.0	Nil
--	PE	CProgram Elective I	3	0	0	3	--	--
--	OE	Open Elective III	3	0	0	3	--	--
ME3641	PC	Measurement and Metrology Lab	0	0	2	1	1.0	Nil
MT3641	PC	Mechatronics Lab	0	0	2	1	1.0	Nil
ME3645	FW	Project Lab IV	0	0	4	2	--	--
VP3601	VP	Employability skill	2	0	0	2	--	--
ME3646	VP	Technical VAP I	2	0	0	2	--	--
GP3601	GP	General Proficiency	0	0	0	1	--	--
		TOTAL	**19**	**2**	**8**	**25**		
All students are required to attend 04 to 06 weeks Industrial Training after 6th semester. Performance of this training will be evaluated and awarded in 7th semester								

Open Elective III

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
CE3015	OE	Hydrology	3	0	0	3	1.0	Nil
CS3025	OE	Data Science Models : Regression, Classification and Clustering	3	0	0	3	1.0	Nil
AG3015	OE	Mushroom Cultivation	3	0	0	3	1.0	Nil
BB3015	OE	E-commerce	3	0	0	3	1.0	Nil
JM3015	OE	Media industry and Management	3	0	0	3	1.0	Nil
HM3015	OE	Italian Cuisine	3	0	0	3	1.0	Nil
MB3015	OE	SAP 5	3	0	0	3	1.0	Nil
EG3015	OE	French Advance C1	3	0	0	3	1.0	Nil
MT3015	OE	Robotic Industry 4.0	3	0	0	3	1.0	Nil

SEMESTER 7

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
ME3701	PC	CAD/CAM	3	2	0	4	1.0	Nil
ME3715	PC	Industrial Engineering and Management	3	0	0	3	1.0	Nil
	PE	Program Elective II	3	0	0	3	1.0	--
	PE	Program Elective III	3	0	0	3	1.0	--
ME3740	PC	CAD/CAM Lab	0	0	2	1	1.0	Nil
ME3743	PC	Industrial Engineering and Quality Control Lab	0	0	2	1	1.0	Nil
ME3745	P	Project Lab V	0	0	4	2	--	--
ME3746	PC	Technical VAP II	2	0	0	2	--	--
ME3771	FW	Internship Presentation III	2	0	0	2	--	--
GP3701	GP	General Proficiency	0	0	0	1	--	--
		TOTAL	**16**	**2**	**8**	**22**		

Contact Hrs: 26

SEMESTER 8

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
	PE	Program Elective IV	3	0	0	3	1.0	--
	PE	Program Elective V	3	0	0	3	1.0	--
ME3870	FW	Project	0	0	8	4	--	--
		TOTAL	**6**	**0**	**8**	**10**		

Contact Hrs: 14

OR

It is the prerogative of the university to allow the student to opt for this option only after completing the process of approval before proceed on full semester internship on an industrial project. The evaluation of internal components will be done jointly by industrial supervisor and university supervisor. End semester evaluation will be done by a committee comprise of atleast one expert from industry/corporate.

Course Code	Category	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
ME3871	FW	Major Industrial Project	0	0	0	10	--	--
		TOTAL	**0**	**0**	**0**	**10**		

List of Program Electives

Elective	Course Code	COURSE TITLE	L	T	P	C	Version	Course Prerequisite
I	ME3604	Gas Dynamics and Jet Propulsion	3	0	0	3	1.0	ME3401
	ME3605	Computational Fluid Dynamics	3	0	0	3	1.0	ME3304
	ME3606	Production Planning and Control	3	0	0	3	1.0	--
	ME3607	Plant Layout and Material Handling	3	0	0	3	1.0	--
	ME3608	Advanced Engineering Material	3	0	0	3	1.0	
	ME3609	Welding Technology	3	0	0	3	1.0	
II	ME3703	Alternative Fuels and Energy Systems	3	0	0	3	1.0	--
	ME3704	Fuels and Combustion	3	0	0	3	1.0	--
	ME3705	Reliability Engineering	3	0	0	3	1.0	--
	ME3706	Statistical Quality Control	3	0	0	3	1.0	--
	ME3707	Finite Element Method	3	0	0	3	1.0	--
	ME3708	Mechanical Vibrations	3	0	0	3	1.0	ME3402
III	ME3709	Waste Heat Recovery Systems	3	0	0	3	1.0	--
	ME3710	Heating Ventilation and Air-conditioning	3	0	0	3	1.0	--
	ME3711	Six Sigma and Applications	3	0	0	3	1.0	--
	ME3712	Quality Assurance and Management	3	0	0	3	1.0	--
	ME3713	Unconventional Manufacturing Processes	3	0	0	3	1.0	--
	ME3714	Plastic Processing and Techniques	3	0	0	3	1.0	--
IV	ME3801	Solar and Thermal Power Engineering	3	0	0	3	1.0	--
	ME3802	Nuclear Power Engineering	3	0	0	3	1.0	--
	ME3803	Supply Chain Management	3	0	0	3	1.0	--
	ME3804	Value Engineering	3	0	0	3	1.0	--
	MT3803	Robotics and Automation	3	0	0	3	1.0	--
	ME3806	Rapid Prototyping	3	0	0	3	1.0	--
V	ME3807	Energy Conservation and Audit	3	0	0	3	1.0	--
	ME3808	Energy Storage Systems	3	0	0	3	1.0	--
	ME3809	Product Design and Development	3	0	0	3	1.0	--
	ME3810	Lean Manufacturing	3	0	0	3	1.0	--
	ME3811	Introduction to Tribology	3	0	0	3	1.0	--
	ME3812	Automotive Pollution and Control	3	0	0	3	1.0	--
Student can also opt for courses in MOOC platform after getting approval from the department.								

B. Choice Based Credit System (CBCS)

Choice Based Credit System (CBCS) is a versatile and flexible option for each student to achieve his target number of credits as specified by the UGC and adopted by our university.

The following is the course module designed for the B.Tech (Mechanical Engineering) program:

Core competency: Students will acquire core competency in Mechanical Engineering and in allied subject areas.

Program/Discipline Specific Elective Course (DSEC):

Skilled communicator: The course curriculum incorporates basics and advanced training in order to make a graduate student capable of expressing the subject through technical writing as well as through oral presentation.

Critical thinker and problem solver: The course curriculum also includes components that can be helpful to graduate students to develop critical thinking ability by way of solving problems/numerical using basic
& advance knowledge and concepts of Mechanical Engineering.

Sense of inquiry: It is expected that the course curriculum will develop an inquisitive characteristic among the students through appropriate questions, planning and reporting experimental investigation.

Skilled project manager: The course curriculum has been designed in such a manner as to enabling a graduate student to become a skilled project manager by acquiring knowledge about mathematical project management, writing, planning, study of ethical standards and rules and regulations pertaining to scientific project operation.

Ethical awareness/reasoning: A graduate student requires understanding and developing ethical awareness/reasoning which the course curriculums adequately provide.

Lifelong learner: The course curriculum is designed to inculcate a habit of learning continuously through use of advanced ICT technique and other available techniques/books/journals for personal academic growth as well as for increasing employability opportunity.

Value Added Program (VAP): A value added program course is a credit course which is basically meant to enhance general ability of students in areas like soft skills, quantitative aptitude and reasoning ability - required for the overall development of a student and at the same time crucial for industry/corporate demands and requirements. The student possessing these skills will definitely develop acumen to perform well during the recruitment process of any premier organization and will have the desired confidence to face the interview. Moreover, these skills are also essential in day-to-day life of the corporate world. The aim is to nurture every student for making effective communication, developing aptitude and a general reasoning ability for a better performance, as desired in corporate world.

Skill Enhancement Course: This course may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge.

Generic/Open Elective Course (OE): Open Elective is an interdisciplinary additional subject that is compulsory in a program. The score of Open Elective is counted in the overall aggregate marks under Choice Based Credit System (CBCS). Each Open Elective paper will be of 3 Credits in III, IV and VI semesters. Each student has to take Open/Generic Electives from department other than the parent department. Core / Discipline Specific Electives will not be offered as Open Electives.

Non CGPA Audit Course (NCAC): This is a compulsory course but audit that does not have any choice and will be of 3 credits. Each student of B.Tech program has to compulsorily pass the Environmental Studies and Human values & professional Ethics.

C. Program Outcomes of Bachelor of Technology in Mechanical Engineering

PO-01	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex civil engineering problems.
PO-02	Problem analysis	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO-03	Design/development of solutions	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO-04	Conduct investigations of complex problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO-05	Modern tool usage	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO-06	The engineer and society	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO-07	Environment and sustainability	Understand the impact of the professional scientific solutions on societal and environmental issues, and impart knowledge and need for sustainable development.
PO-08	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO-09	Individual and Team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO-10	Communication	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO-11	Project Management and Finance	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO-12	Life-long learning	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological Change

D. Program Specific Outcomes:

PSO1: Apply their engineering knowledge in the domain of manufacturing, thermal and design to develop solution for engineering problems.

PSO2: To develop the ability to provide solutions using cutting edge technologies and modern tools.

E. Program Educational Objectives (PEO's)

PEO1: Able to apply concepts of mathematics, science and computing to Electronics and Communication Engineering

PEO2: Able to design and develop interdisciplinary and innovative systems.

PEO3: Able to inculcate effective communication skills, team work, ethics, leadership in preparation for a successful career in industry and R&D organizations

F. Pedagogy & Unique practices adopted:

""Pedagogy is the method and practice of teaching, especially for teaching an academic subject or theoretical concept". In addition to conventional time-tested lecture method, the institute will emphasize on experiential learning:

Mini projects: students are asked to do or given mini projects for developing an aptitude to critically think and find solutions for real world problems, learn working with other people, under deadlines and guidance.

Flip Presentations: Students are required to present on latest technology trends in mechanical engineering to enhance their ability to self learn and presentation skill along with developing their confidence level to face an audience.

Field/Live Projects: The students, who take up experiential projects in companies, where senior executives with a stake in teaching guide them, drive the learning. All students are encouraged to do some live project other their regular classes.

Project Lab:This course is spread across the semesters, from 3rd semester till seventh semester where student is required to do a design project or field work or design, fabrication and testing of materials/machines.

Industrial Visits: Industrial visit are essential to give students hand-on exposure and experience of how things and processes work in industries. Our institute organizes such visits to enhance students' exposure to practical learning and work out for a report of such a visit relating to their specific topic, course or even domain.

MOOCs: Students may earn credits by passing MOOCs as decided by the college. Graduate level programs may award Honors degree provided students earn pre-requisite credits through MOOCs. University allows students to undertake additional subjects/course(s) (In-house offered by the university through collaborative efforts or courses in the open domain by various internationally recognized universities) and to earn additional credits on successful completion of the same. Each course will be approved in advance by the University following the standard procedure of approval and will be granted credits as per the approval. Keeping this in mind, University proposed and allowed a maximum of two credits to be allocated for each MOOC courses. In the pilot phase it is proposed that a student undertaking and successfully completing a MOOC course through only NPTEL could be given 2 credits for each MOOC course.

For smooth functioning and monitoring of the scheme the following shall be the guidelines for MOOC courses, Add-on courses carried out by the College from time to time.

a) It will necessary for every student to take at least one MOOC Course throughout the programme.

b) There shall be a MOOC co-ordination committee in the College with a faculty at the level of Professor heading the committee and all Heads of the Department being members of the Committee.

c) The Committee will list out courses to be offered during the semester, which could be requested by the department or the students and after deliberating on all courses finalize a list of courses to be offered with 2 credits defined for each course and the mode of credit consideration of the student. The complete process shall be obtained by the College before end of June and end of December for Odd and Even semester respectively of the year in which the course is being offered. In case of MOOC course, the approval will be valid only for the semester on offer.

d) Students will register for the course and the details of the students enrolling under the course along with the approval of the Vice Chancellor will be forwarded to the Examination department within fifteen days of start of the semester by the Coordinator MOOC through the Principal of the College.

e) After completion of MOOC course, Student will submit the photo copy of Completion certificate of MOOC Course to the

Examination cell as proof.

f) Marks will be considered which is mentioned on Completion certificate of MOOC Course.

g) College will consider the credits only in case a student fails to secure minimum required credits then the additional subject(s) shall be counted for calculating the minimum credits required for the award of degree.

Special Guest Lectures (SGL) & Extra Mural Lectures (EML): Some topics/concepts need extra attention and efforts as they either may be high in difficulty level or requires experts from specific industry/domain to make things/concepts clear for a better understanding from the perspective of the industry. Hence, to cater to the present needs of industry we organize such lectures, as part of lecture-series and invite prominent personalities from academia and industry from time to time to deliver their vital inputs and insights.

Student Development Programs (SDP): Harnessing and developing the right talent for the right industry an overall development of a student is required. Apart from the curriculum teaching various student development programs (training programs) relating to soft skills, interview skills, SAP, Advanced excel training etc. that may be required as per the need of the student and industry trends, are conducted across the whole program. Participation in such programs is solicited through volunteering and consensus.

Industry Focused programmes: Establishing collaborations with various industry partners to deliver the programme on sharing basis. The specific courses are to be delivered by industry experts to provide practice-based insight to the students.

Special assistance program for slow learners & fast learners: write the note how would you identify slow learners, develop the mechanism to correcting knowledge gap. Terms of advance topics what learning challenging it will be provided to the fast learners.

Induction program: Every year 3 weeks induction program is organized for 1st year students and senior students to make them familiarize with the entire academic environment of university including Curriculum, Classrooms, Labs, Faculty/ Staff members, Academic calendar and various activities.

Mentoring scheme: There is Mentor-Mentee system. One mentor lecture is provided per week in a class. Students can discuss their problems with mentor who is necessarily a teaching faculty. In this way, student's problems or issues can be identified and resolved.

Competitive exam preparation: Students are provided with one class in every week for GATE/ Competitive exams preparation.

Extra-curricular Activities: organizing & participation in extracurricular activities will be mandatory to help students develop confidence & face audience boldly. It brings out their leadership qualities along with planning & organizing skills. Students undertake various cultural, sports and other competitive activities within and outside then campus. This helps them build their wholesome personality.

Career & Personal Counseling: - Identifies the problem of student as early as possible and gives time to discuss their problems individually as well as with the parents. Counseling enables the students to focus on behavior and feelings with a goal to facilitate positive change. Its major role lies in giving: Advice, Help, Support, Tips, Assistance, and Guidance.

Participation in Flip Classes, Project based Learning(A2 Assignment), Workshops, Seminars & writing & Presenting Papers: Departments plan to organize the Flip Classes, Project based Learning(A2 Assignment), workshops, Seminars & Guest lecturers time to time on their respective topics as per academic calendar. Students must have to attend these programs. This participation would be count in the marks of general Discipline & General Proficiency which is the part of course scheme as non-credit course.

Formation of Student Clubs, Membership & Organizing & Participating events: Every department has the departmental clubs with the specific club's name. The entire student's activity would be performed by the club. One faculty would be the coordinator of the student clubs & students would be the members with different responsibility.

Capability Enhancement & Development Schemes: The Institute has these schemes to enhance the capability and holistic development of the students. Following measures/ initiatives are taken up from time to time for the same: Career Counseling, Soft skill development, Remedial Coaching, Bridge Course, Language Lab, Yoga and Meditation, Personal Counseling

Library Visit & Utilization of QLRC: Students may visit the library from morning 10 AM to evening 8 PM. Library created its resources Database and provided Online Public Access Catalogue (OPAC) through which users can be accessed from any of the computer connected in the LAN can know the status of the book. Now we are in process to move from OPAC to KOHA.

Detailed Syllabus (Semester wise /course wise)

SEMESTER 1 Year -1

MA3102	**Title: Mathematics-I**	**L T P C** **3 2 0 4**
Version No.	**1.0**	
Course Prerequisites	Nil	
Objectives	To provide essential knowledge of basic tools of Differential Calculus, Integral Calculus, Vector Calculus and Matrix Algebra.	
Unit Nos.	**Unit Title**	**Number of hours (per Unit)**
Unit 1	**Matrix Algebra**	8
Elementary operations and their use in getting the Rank, Inverse of a matrix and solution of linear simultaneous equations. Eigen-values and Eigenvectors of a matrix, Symmetric, Skew-symmetric, Hermitian, Skew-Hermitian, Orthogonal and Unitary matrices and their properties, Cayley- Hamilton theorem, Diagonalization of a matrix		
Unit II	**Differential Calculus**	8
Limit, Continuity and differentiability of functions of two variables, Euler's theorem for homogeneous equations,. Change of variables, chain rule, Jacobians, Taylor's Theorem for two variables, Error approximations. Extrema of functions of two or more variables, Lagrange's method of undetermined multipliers		
Unit III	**Integral Calculus**	6
Review of curve tracing and quadric surfaces, Double and Triple integrals, Change of order of integration. Change of variables.		
Unit IV	**Application of Multiple Integration**	6
Gamma and Beta functions. Dirichlet's integral. Applications of Multiple integrals such as surface area, volumes, centre of gravity and moment of inertia.		
Unit V	**Vector Calculus**	8
Differentiation of vectors, gradient, divergence, curl and their physical meaning. Identities involving gradient, divergence and curl. Line and surface integrals. Green's, Gauss and Stroke's theorem and their applications.		
Text Books	1. R.K. Jain and S.R.K. Iyenger, Advanced Engineering Mathematics, Narosa Publishing House	
Reference Books	1. E. Kreyszig, Advanced Engineering Mathematics, John Wiley andSons 2. M.D. Weir, J. Hass, F.R. Giordano, Thomas' Calculus, PearsonEducation	
Mode of Evaluation	Internal and External Examinations	
Recommend a tionbyBoard of Studieson	13-06-2019	
Date of approval by the Academic Council	13-7-2019	

Course Outcome for MA3102

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to learn the basic principles of multi-variable calculus with their proofs. They should be able to classify partial differential equations and transform them into canonical form. They will also understand how to extract information from partial derivative models in orderto interpret reality.	2	Em
CO2	Students should be able to understand and learn how to find the area and volume of any region and solid body resectively by integral and also find the moments of inertiafor a thin plate in plane.	2	S
CO3	Students should be able to understand theorems related to directional derivative of gradient and reproduce its proof. They should be able to Explain the concept of a vectorintegration in a plane and in space.	3	S
CO4	Students should be able to know basic application problems described by second order linear differential equations with constant coefficients. They should be also able to understand and solve the applications associatedwithLaplace Transform.	3	En
CO5	Students should be able to solve the linear equations using matrix properties and Determine characteristic equation,eigen values, eigenvectors and diagonalizable of a matrix.	3	None

CO-PO Mapping for MA3102

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	1	1	1	3	2	1	2	3	1	2	1	2	2
CO 2	3	3	2	3	3	3	2	3	1	3	3	1	1	3
CO 3	2	3	2	2	1	1	3	1	1	2	2	3	2	3
CO 4	2	3	3	3	3	3	3	2	2	2	2	3	1	1
CO 5	3	2	2	2	3	2	1	2	2	2	2	2	1	3
Avg.	2.6	2.4	2	2.2	2.6	2.2	2	2	1.8	2	2.2	2	1.4	2.4

PS3101	Title: Human Values and Ethics	L T P C 2 0 02
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To facilitate the development of a holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the human reality and the rest of existence	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction of Value Education	5
1. Understanding the need, basic guidelines, content and process of ValueEducation 2. A look at basic Human Aspirations: Self Exploration–its content andprocess		
Unit II	Understanding Harmony - Harmony in Myself!	5
1. Thoughtfulhumanbeinginharmony;asaco-existenceofthesentient,attitudeand itsimportanceinrelationship. 2. Understanding the needs, characteristics and activities of Self('I')		
Unit III	Understanding Harmony in the Family and Society	5
1. Harmony in the family; values in human relationships; meaning of Nyaya , Trust (Vishwas) and Respect (Samman)as the foundation values of relationships. 2. Harmony in society:Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals.		
Unit IV	Understanding Harmony in the Nature and Existence	4
1. Understanding the harmony in Nature: Interconnectedness among the four orders of nature- recyclability and self- regulation in nature 2. Natural perception of harmony at all levels of existence		
Unit V	Understanding Professional Ethics	5
1. Competencies in professionalethics: a) Ability to utilize the professional competence for augmenting universal humanorder b) Abilitytoidentifythescopeandcharacteristicsofpeople-friendlyandeco-friendlyproductionsystems, c) Abilitytoidentifyanddevelopappropriatetechnologiesand managementpatternsforaboveproductionsystems.		
Text Books	1. R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and Professional Ethics, Excel books, New Delhi	
Reference Books	1. A.N. Tripathy, Human Values, New Age InternationalPublishers 2. B L Bajpai, Indian Ethos and Modern Management, New Royal Book Co.,Lucknow 2. B P Banerjee, Foundations of Ethics and Management, Excel Books	
Mode of Evaluation	Internal and External Examinations	
Recommendation byBoard of Studies on	13-06-2019	
Date of approval by theAcademic Council	13-7-2019	

Course Outcome for PS 3101

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society.	2	Em
CO2	Students should be able to distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body.	2	S
CO3	Students should be able to understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society.	2	S
CO4	Students should be able to understand the harmony in nature and existence, and work out their mutually fulfilling participation in the nature.	2	En
CO5	Students should be able to distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.	3	None

CO-PO Mapping for PS 3101

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	2	3	3	2	2	3	2	1	1	3	3	1	3
CO 2	2	2	3	2	3	3	1	2	1	1	1	3	3	2
CO 3	2	2	1	1	1	2	2	2	2	1	1	2	3	2
CO 4	1	1	3	2	2	2	2	3	2	3	2	2	2	1
CO 5	2	1	2	2	2	1	2	2	1	3	3	2	3	1
Avg.	1.8	1.6	2.4	2	2	2	2	2.2	1.4	1.8	2	2.4	2.4	1.8

EC3101	Title: Basic Electrical and Electronics Engineering	L T P C 3 0 03
Version No.	1.1	

Course Prerequisites	Nil	
Objectives	To provide an overview of electrical and electronics fundamentals.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Basic Concepts of Electrical Engineering	7
Electric Current, Electromotive force, Electric Power, Ohm's Law, Basic Circuit Components, Faraday's Law of Electromagnetic Induction, Lenz's Law, Kirchhoff's laws, Network Sources, Resistive Networks, Series-Parallel Circuits, Node Voltage Method, Mesh Current Method, Superposition, Thevenin's, Norton's and Maximum Power Transfer Theorems.		
Unit II	Transformers and Alternating Quantities	7
Transformers: Construction, EMF equation, ratings, phasor diagram on no load and full load, equivalent circuit, regulation and efficiency calculations, open and short circuit tests, auto-transformers. Alternating Quantities: Introduction, Generation of AC Voltages, Root Mean Square and Average Value of Alternating Currents and Voltages, Form Factor and Peak Factor, Phasor Representation of Alternating Quantities, Single Phase RLC Circuits, Introduction to 3-Phase AC System.		
Unit III	Rotating Electrical Machines	8
DC Machines: Principle of Operation of DC Machine, EMF Equation, Applications of DC Machines. AC Machines: Principle of Operation of 3-Phase Induction Motor, 3-Phase Synchronous Motor and 3- Phase Synchronous Generator (Alternator), Applications of AC Machines.		
Unit IV	Basic Electronics	7
Conduction in Semiconductors, Conduction Properties of Semiconductor Diodes, Behavior of PN Junction, PN Junction Diode, Zener Diode, Photovoltaic Cell, Rectifiers, Bipolar Junction Transistor, Field Effect Transistor, Transistor as an Amplifier.		
Unit V	Digital Electronics and Electrical Measuring Instruments	7
Digital Electronics: Boolean algebra, Binary System, Logic Gates and Their Truth Tables. Kaurnugh Map Electrical Measuring Instruments: Basic OP-AMP, Differential amplifier, PMMC instruments, shunt and series multipliers, multimeters, Moving iron ammeters and voltmeters, dynamometer, wattmeter, AC watthour meter, extension of instrument ranges.		
Text Books	1. V. Jagathesan, K. Vinod Kumar and R. Saravan Kumar, Basic Electricaland Electronics Engineering, WileyIndia 2. SukhijaandNagsarkar,BasicElectricalandElectronicsEngineering,Oxford Publication	
Reference Books	1. Kothari, Nagrath, Basic Electrical and Electronics Engineering,TMH 2. Prasad/Sivanagraju,BasicElectricalandElectronicsEngineering,Cengagelearning IndianEdition 3. Muthusubrmaniam, Basic Electrical and Electronics Engineering,TMH	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-7-2019	

Course Outcome for EC 3101

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to understand the basic theorms used in simplifying the electrical circuits.	3	Em
CO2	Students should be able to Know about the generation and utilization of three phase alternating quantities.	3	S
CO3	Students should be able to Know about single phase transformer and its various parameters.	2	S
CO4	Students should be able to understand the various components used in electronics like P-N junction and Zener dioide.	2	En
CO 5	Students should be able to understand basics of digital electronics and various electrical measurement devices.	3	None

CO-PO Mapping for EC3101

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	1	1	3	2	1	2	1	1	3	1	2	1
CO 2	3	3	2	3	3	2	3	2	1	1	3	3	2	1
CO 3	2	2	2	2	2	3	2	2	2	2	1	2	2	1
CO 4	1	1	1	2	2	1	3	2	2	3	2	2	3	3
CO 5	2	2	3	3	2	3	1	3	1	2	3	3	1	3
Avg.	2.2	2	1.8	2.2	2.4	2.2	2	2.2	1.4	1.8	2.4	2.2	2	1.8

EG3102	**Title: Professional Communication**	**L T P C** **2 0 02**
Version No.	**1.0**	
Course Prerequisites	Nil	
Objectives	To introduce students to the theory, fundamentals and tools of communication and to develop in them vital communication skills	
Unit No.	**Unit Title**	**No. of hours (per Unit)**
Unit I	**Fundamentals of Communication**	5
Introduction–Communication Process, Distinction between General and Technical Communication.Language as a Tool of Communication; Interpersonal, Organizational, Mass Communication. Formal Communication: Downward, Upward, Lateral/ Horizontal, Diagonal; Informal Communication (Grapevine).Barriers to Communication		
Unit II	**Components of Technical Written Communication**	5
Vocabulary building: Synonyms and Antonyms, Homophones, Conversions. Common Grammatical Errors, Paragraph Development, Précis writing.Technical Papers: Project, Dissertation andThesis.		
Unit III	**Forms of Business Communication**	5
Business Correspondence- Types:, Memorandum; Official letters.Job Application, Resume/CV/Bio-data; Notice, Agenda, Minutes of Meetings.Technical Proposal: Types, Significance, Format and Style of Writing Proposals.Technical Report: Types, Significance, Format and Style of Writing Reports.		
Unit IV	**Presentation Techniques and Soft Skills**	5
Presentation: Defining Purpose, Audience and Location; Organizing Contents; Preparing Outline; Audio-Visual Aids in Presentations.Non-Verbal Aspects of Presentation: Kinesics, Proxemics, Chronemics, Paralanguage. Listening Skills: Importance, Active and Passive listening. Speaking Skills: Common Errors in Pronunciation; Vowels, Consonants and Syllables; Accent, Rhythm and Intonation.		
Unit V	**Value-based Text Readings**	4
Thematic and value-based critical reading of the following essays with emphasis on the mechanics of writing and speaking:1.The Language Of Literature And Science by Aldous Huxley 2.Of Discourse by Francis Bacon		
Suggested Reference Books	1. Barun K. Mitra, Effective Technical Communication, Oxford Univ.Press 2. Meenakshi Raman and Sangeeta Sharma, Technical Communication-Principles andPractices, OxfordUniv.Press 3. Prof.R.C.Sharma and Krishna Mohan, Business Correspondence and ReportWriting,Tata McGraw Hill and Co.Ltd. NewDelhi 4. V.N.AroraandLaxmiChandra,ImproveYourWriting,OxfordUniv.Press,NewDelhi 5. Ruby Gupta, Basic TechnicalCommunication	
Mode of Evaluation	Internal and External Examinations	
Recommendation byBoard of Studies on	13-06-2019	
Date of approval by theAcademic Council	13-7-2019	

Course Outcome for EG3102

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to learn the fundamentals of communication process used within the organization.	2	Em
CO2	Students should be able to learn about the components of Technical Written Communication.	2	S
CO3	Students should be able to learn about the different forms of Business Communication.	2	S
CO4	Students should be able to learn presentation techniques and soft skills.	2	En
CO5	Students should be able to understand Value-based Text Readings.	2	None

CO-PO Mapping for EG 3102

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	1	1	1	2	1	3	1	2	2	2	2	2	2
CO 2	1	1	2	2	3	3	3	1	3	3	2	3	2	1
CO 3	2	1	1	2	1	2	3	1	2	3	2	2	1	2
CO 4	2	2	1	1	1	2	1	3	3	3	1	2	1	2
CO 5	2	2	2	2	3	3	1	2	3	3	2	2	1	2
Avg.	1.8	1.4	1.4	1.6	2	2.2	2.2	1.6	2.6	2.8	1.8	2.2	1.4	1.8

CS3101	Title: Basics of Computer and C Programming	L T P C 4 0 0 4
Version No.	1.1	
Course Prerequisites	Nil	
Objective	This subjects aims to make student handy with the computers basics and programming.	
Unit No.	Unit Title	No. of Hrs (Per Unit)
Unit I	Architecture of Computer	10
What is Computer: Brief History and Evolution Chain, Concept of Hardware, The Inside Computer [Hard Drives (HD),Solid State Drives (SSD), Concept of CPU, Concept Of RAM], The Peripherals [Input Devices: Keyboard, Mouse, Media Devices [Floppy, DVD ROM, CD ROM, USB Storage Drive], Scanner], Output Devices [Monitor, Printer, Speaker.		
Unit II	Arithmetic of Computer	10
Number System [Decimal, Binary, Octal, Hexadecimal], Conversions, Binary Arithmetic [Addition, Subtraction, Multiplication, Division, 1s Compliment, 2s Compliment], Floating Point Arithmetic [IEEE 754 Concept, Storage of Floating Point Numbers]		
Unit III	Algorithms and Flow Chart	9
Algorithm [What is Algorithm? Algorithm Writing Examples] Flow Chart [What is Flow Chart? Flow Chart Symbols,How to make Flow Chart? Types of Flow Chart, Flow Chart Examples]		
Unit IV	Basics of C Programming –Part 1	9
Types of Computer Languages:-Machine Language, Assembly Language and High Level Language, Concept of Compiler, Assembler, Linker and Loader. Fundamental Data Type: int, float, char and void. Qualifier for int (long and short), singed and unsigned numbers. Program vs. Process, Storage Classes: auto, static, extern and register. Operatorvs. Operand. Operators: Arithmetic, Relational, Conditional and Logical.		
Unit V	Basics of C Programming – Part 2	10
Functions: Introduction [Function Definition, Declaration and Call], Types of Functions, Basic Programs, RecursiveFunction. Arrays: Introduction, Array Notation and Representation, Basic Programs, Types of Arrays [1-D, 2-D and n- D Array]. Pointer: Introduction, Declaration, Initialization and Access of data using pointer		
Text Books	1. "Mastering C" by KRVenugopal 2. "Let us C" by Y.kanetkar 3. "Programming in ANSI C" by E. Balagurusamy.	
Reference Books	1. Kernighan, B.W and Ritchie, D.M, "The C Programming language", Pearson Education 2. 2. Byron S Gottfried, " Programming with C", Schaum's Outlines Tata McGraw-Hill	
Mode of Evaluation	Internal and External Examinations	
Recommended by Board of Studied on	07-06-2019	
Date of approval by theAcademic Council	13-7-2019	

Course Outcome for CS3101

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to understand Computer and its Components, will be able to understand Number Systems and their conversion and carry out operations associated with them.	2	Em
CO2	Students should be able to use the C programming language to implement various algorithms, and acquire the basic concepts and terminology of programming in C.	2	S
CO3	Students should be able to understand arrays, their functions that will help them to design new problem solving approach in 'C'.	2	S
CO4	Students should be able to understand pointers, recursion, and macros for solving complex problems in 'C'.	2	En
CO5	Students should be able to gain a broad perspective about the uses of computers in engineering industry.	2	None

CO-PO Mapping for CS3101

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	2	3	2	3	3	3	1	1	3	3	2	1	2
CO 2	3	2	1	2	3	2	1	1	1	1	1	2	2	3
CO 3	3	1	1	2	1	2	2	2	2	1	1	3	2	2
CO 4	2	1	2	3	3	3	3	1	3	1	2	3	2	1
CO 5	1	3	2	3	1	1	2	1	2	1	1	2	2	1
Avg.	2.2	1.8	1.8	2.4	2.2	2.2	2.2	1.2	1.8	1.4	1.6	2.4	1.8	1.8

EG3140	Title: Professional Communication LAB	L T P C 0 0 21
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To provide practice to students in an interactive manner to apply the fundamentals and tools of English communication to life situations	

List of Experiments

1. Common conversation skills
2. Introductions
3. Making requests
4. Asking for permission
5. Asking questions
6. Describing events, people, places
7. Learning correct pronunciation, syllable, stress, intonation
8. Extempore speaking
9. Roleplay
10. Presentation skills
11. Grammar-tense practice
12. Mother tongue influence-correction
13. Speech making / publics peaking
14. Listening effectively
15. E-mail Etiquettes

Mode of Evaluation	Internal and External Examinations
Recommendation byBoard of Studies on	13-06-2019
Date of approval by theAcademic Council	13-7-2019

Course Outcome for EG 3140

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to improve communication skills (Reading, Writing, Speaking & Listening).	3	Em
CO2	Students should be able to achieve grammatical competency in drafting documents.	3	S
CO3	Students should be able to identify different situations & react accordingly using appropriate communication skills.	3	S

CO-PO Mapping for EG3140

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	2	1	2	1	1	3	2	1	2	2	2	1	2
CO 2	2	1	1	2	2	2	1	2	1	2	1	2	3	2
CO 3	2	2	2	3	3	2	1	1	3	3	3	2	1	3
Avg	2	1.6	1.3	2.3	2	1.67	1.67	1.67	1.67	2.3	2	2	1.67	2.3

CS3140	Title: Basics of Computer and C Programming LAB	L T P C 0 0 21
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	Learning objectives is to improve confidence in technology use andincreased awareness of opportunities afforded to individuals with computer application skills.	

List of Experiments

1. Programs using I/O statements andexpressions.
2. Programs using decision-makingconstructs.
3. Write a program to find whether the given year is leap year or Not? (Hint: not every centurion year is a leap. Forexample 1700, 1800 and 1900 is not a leap year)
4. Design a calculator to perform the operations, namely, addition, subtraction, multiplication, division and squareof a number.
5. Check whether a given number is Armstrong number ornot?
6. Populate an array with height of persons and find how many persons are above the average height.
7. Populate a two dimensional array with height and weight of persons and compute the Body Mass Index of the individuals.
8. Given a string — a$bcd./fg‖ find its reverse without changing the position of special characters. (Example input: a@gh%;j and output:j@hg%;a)
9. Convert the given decimal number into binary, octal and hexadecimal numbers using user defined functions.
10. From a given paragraph perform the following using built-in functions:
    a. Find the total number of words.
    b. Capitalize the first word of each sentence.
    c. Replace a given word with another word.
11. Solve towers of Hanoi using recursion.
12. Sort the list of numbers using pass by reference.
13. Generate salary slip of employees using structures and pointers.
14. Compute internal marks of students for five different subjects using structures and functions.
15. Insert, update, delete and append telephone details of an individual or a company into a telephone directory using random access file

Mode of Evaluation	Internal and External Examinations
Recommendation byBoard of Studies on	13-06-2019
Date of approval by theAcademic Council	13-7-2019

Course Outcome for CS 3140

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to approach the programming tasks using techniques learned in Theory and write pseudo-codes based on the requirements of the problem.	3	Em
CO2	Students should be able to use the comparisons and limitations of the various programming constructs and choose the right one for the task in hand.	3	S
CO3	Students should be able to write the program based on numerical techniques learned and able to edit, compile, debug, correct, recompile and run it.	3	S

CO-PO Mapping for CS 3140

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	1	3	1	1	3	3	3	1	1	3	3	1
CO 2	2	1	1	1	3	3	3	1	1	2	3	3	1	1
CO 3	2	3	1	2	1	2	3	3	3	2	2	2	3	2
Avg.	2.3	2	1	2	1.6	2	3	2.3	2.3	1.67	2	2.6	2.33	1.3

EC3140	Title: Basic Electrical and Electronics Engineering lab	L T P C 0 0 2 1
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To make students familiar with the fundamental laws featuring in the field of Electrical and Electronics Engineering.	

List of Experiments

1. To verify the Kirchhoff's current and voltage laws.
2. To verify the Superposition theorem.
3. To verify the Thevenin's theorem.
4. To verify the Norton's theorem.
5. To verify the maximum power transfer theorem.
6. To study the V-I characteristics of p-n junction diode.
7. To study the diode as clipper and clamper.
8. To study the half-wave and full-wave rectifier using silicon diode.
9. To study transistor in Common Base configuration and plot its input/output characteristics.
10. 10.To study various logic gates and verify their truth tables.

Mode of Evaluation	Internal and External Examinations
Recommendation by Board of Studies on	13-06-2019
Date of approval by the Academic Council	13-7-2019

Course Outcome for EC3140

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to know about the basic concepts of the Kirchhoff's current and voltage laws and perform Thevenin's, Norton's, superposition and maximum power transfer theorems.	3	Em
CO2	Students should be able to analyze and understand the characteristics of transistors and semiconductor diodes and analyze the half-wave and full-wave rectifier using silicon diode.	4	S
CO3	Students should be able to Learn the basic concepts of various logic gates.	2	S

CO-PO Mapping for EC3140

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	2	1	2	1	2	1	1	2	2	3	2	2	1
CO 2	2	1	1	1	2	2	2	1	3	1	1	1	1	2
CO 3	2	3	3	2	2	2	2	1	2	2	2	2	2	2
Avg.	2	2	1.67	1.67	1.67	2	1.67	1	2.3	1.67	2	1.67	1.67	1.67

ME3141	Title: Engineering Graphics	L T P C 0 0 42
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To enable students to acquire and use engineering drawing skills as a means of accurately and clearly communicating ideas, information and instructions through drafting exercises.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction, Projection of Points, Projection of Straight Lines	12
Introduction to Engineering Equipments, Elements of Engineering Drawing, dimensioning, Types of Lines, Various types of projections, First and third angle systems of orthographic projections. Projections of points in different quadrants.Projection of Lines.		
Unit II	Projection of Planes	8
Introduction, types of planes, Projection of planes by change of position method only, projection of plane perpendicular to a plane, with axis parallel to both planes, with axis parallel to one plane and inclined to the other plane.		
Unit III	Projection of Solids	12
Types of solids, Projections of solid in different axis orientations.		
Unit IV	Section of Solids	8
Introduction - section planes - apparent section - true section - sectional view - need for sectional view - cutting plane -cuttingplaneline.Sectional viewofsimplesolids.Sectionplaneperpendicular tooneplaneandparallelto theother, section plane perpendicular to one plane and inclined to the other.		
Unit V	Development of Surfaces, Orthographic views (First Angle Projection Only)	8
Development of surface of various solids in simple positions, Three orthographic views of solids.		
Text Books	1 N.D. Bhatt and V.M. Panchal, Engineering Drawing: Plane and Solid Geometry, Charotar Publishing House	
Reference Books	1. Amar Pathak, Engineering Drawing, Dreamtech Press, NewDelhi 2. T.Jeyapoovan,EngineeringGraphicsusingAUTOCAD2000,VikasPublishingHouse 3. Thomas E. French, Charles J. Vierck, Robert J. Foster, Engineering Drawing and Graphic Technology, McGraw Hill InternationalEditions 4. P.S. Gill, Engineering Graphics and Drafting, S.K. Kataria andSons	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-7-2019	

Course Outcome for ME3141

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students will be able to know about basic concepts of projection and To Draw the projection of points and lines located in different quadrants	3	Em
CO2	Students will be able to Draw the projection of plane surfaces in various positions	3	S
CO3	Students will be able to Draw the projection of solids in various positions	3	S
CO4	Students will be able to Draw sectional views of agiven object	3	En
CO5	Students will be able to develop surfaces and draw orthographic view of given object	3	None

CO-PO Mapping for ME3141

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO 1	3	3	2	1	2	1	1	1	1	2	1	1	3	1
CO 2	3	3	2	2	1	2	1	1	2	1	1	1	3	2
CO 3	2	2	3	1	2	1	2	1	2	2	1	2	2	1
CO 4	3	2	2	1	2	1	1	1	1	2	1	2	3	2
CO 5	3	3	2	2	2	1	1	1	1	2	1	1	3	1
Avg	2.8	2.6	2.2	1.4	1.8	1.2	1.2	1	1.4	1.8	1	1.4	2.8	1.4

MA3202	Title: Mathematics II	L T P C 3 2 0 4
Version No.	1.0	
Course Prerequisites	MA3102	
Objectives	This course is designed to give a comprehensive coverage at an introductory level to the subject of Partial Differential Equations,Numerical and Statistical Techniques.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Partial Differential Equations	8
Introduction to Partial differential equations, Linear partial differential equations with constant coefficients of second order. Method of separation of Variables for solving PDE, One dimensional wave equation, Laplace equation in two-dimensions, Heat conduction equations of one dimension.		
Unit II	Fourier series	6
Trigonometric Fourier series and its convergence. Fourier series of even and odd functions. Fourier half-range series.		
Unit III	Numerical Methods	6
Solution of transcendental and algebraic equations: Bisection method, Regula False method, Newton-Raphson method; Solution of system of linear equations: LU-decomposition method, Jaccobi method, Gauss-Seidel method.		
Unit IV	Interpolation	7
Interpolation: difference tables, Newton formulae, Lagrange interpolation and Newton's divided difference interpolation. Numerical integration: Trapezoidal, Simpsons 1/3rd and 3/8th rules,Solution of first and second order ordinary differential equations: Euler, Modified Euler, Runge-Kutta Methodof fourth order.		
Unit V	Complex Variable, Probability and Distributions	9
Analytic functions; Cauchy-Riemann equations; Cauchy's integral theorem and integral formula; Taylor and Laurent series. Probability and Statistics: Definitions of probability, conditional probability; mean, median, mode and standard deviation; Random variables, Binomial, Poisson and Normal distributions.		
Text Books	1. R.K. Jain and S.R.K. Iyenger, Advanced Engineering Mathematics, Narosa Publishing House.	
Reference Books	1. E. Kreyszig, Advanced Engineering Mathematics, JohnWiley and Sons, Inc., U.K. 2. M.D. Weir, J. Hass, F.R. Giordano, Thomas' Calculus, Pearson Education.	
Mode of Evaluation	Internal and External	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

ourse Outcome for MA 3202

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to understand ordinary differential equations, with their solutions through constant coefficients. They will also learn about Euler- Cauchy equations, Solution of second order differential equations by changing dependent and independent variables.	3	Em
CO2	Students should be able to understand the properties of Fourier series. and the relationship between Fourier series and linear time invariant system.	2	S
CO3	Students should be able to learn the basics of the theory of error and the approximation theory; the fundamental principles of mathematical modeling; the numerical methods for solving problems of algebra; and the methods of numerical integration and differentiation.	2	S
CO4	Students should be able to learn about Interpolation which is a useful mathematical and statistical tool used to estimate values between two points.	2	En
CO5	Students should be able to formulate and solve problems involving random variables and apply statistical methods for analysing experimental data. They will also learn to analyse the complex function with reference to their analyticity, integration using Cauchy's integral and residue theorems. Taylor's and Laurent's series expansions of complex function will be also explored at the end of Unit.	1	None

CO-PO Mapping for MA 3202

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO 1	3	2	2	1	1	1	1	1	1	2	2	1	3	2
CO 2	2	2	2	1	1	2	1	1	2	1	1	1	3	2
CO 3	2	3	2	1	1	1	1	1	1	2	2	1	3	2
CO 4	3	2	1	2	1	1	1	1	1	2	1	1	2	1
CO 5	3	2	1	2	1	1	1	1	1	2	2	1	3	1
Avg	2.4	2.2	1.6	1.4	1	1.2	1	1	1.2	1.8	1.6	1	2.8	1.6

PH3101	Title: Engineering Physics	L T P C 2 2 0 3
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	Students will be able to understand the basic of classical and modernphysics and quantum mechanics and electromagnetic concepts with basic knowledge of optics.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Relativistic Mechanics	5
Inertial and Non-inertial Frames, Postulates of Special Theory of Relativity, Galilean and Lorentz Transformation, Length Contraction and Time Dilation, Addition of Velocities, Mass Energy Equivalence and Variation of Mass with Velocity. Radiation**:** Kirchhoff's Law, Stefan's law (only statement), Energy spectrum of Blackbody Radiation, Compton Effect.		
Unit II	Interference and Diffraction	5
Coherent Sources, Conditions of Interference, Fresnel's Bi-prism Experiment, Displacement of Fringes, Interference inThin Films – Wedge Shaped Film, Newton's Rings. Diffraction: Single Slit Diffraction, Diffraction Grating, Raleigh's Criterion of Resolution, Resolving Power of Grating.		
Unit III	Polarization and Laser	5
Phenomenon of Double Refraction, Ordinary and Extra-ordinary Rays, Nicol Prism, Production and Analysis of Plane,Circularly and Elliptically Polarized Light. Laser**:** Principle of Laser Action, Einstein's Coefficients, Construction and Working of He-Ne and Ruby Laser.		
Unit IV	Electromagnetic and Magnetic Properties of Materials	5
Ampere's Law and Displacement Current, Maxwell's Equations in Integral and Differential Forms, ElectromagneticWave Propagation in Free Space and Conducting Media, Poynting Theorem. Basic Concept of Para, Dia and Ferro-Magnetism.		
Unit V	Wave Mechanics	4
Wave Particle Duality, de Broglie Concept of Matter Waves, Heisenberg Uncertainty Principle and its applications, Schrödinger Wave Equation and Its Applications: Particle in a Box (one dimensional only).		
Text Books	1. Beiser, Concepts of Modern Physics, Mc-GrawHill 2. Dr Amit Dixit, Engineering Physics, Nano EdgePublicatons	
Reference Books	1. Robert Resnick, Introduction to Special theory of Relativity,Wiley 2. Ajoy Ghatak, Optics,TMH 3. David J. Griffith, Introduction to Electrodynamics,PHI 4. William Hayt, Engineering Electromagnetics,TMH	
Mode of Evaluation	Internal and External Examinations	
Recommendation byBoard of Studies on	13-06-2019	
Date of approval by theAcademic Council	13-7-2019	

Course Outcome for PH3101

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to understand special theory of realtivity (STR), concepts linked with STR and radiation laws. extract information from partial derivative models in order to interpret reality.	3	Em
CO2	Students should be able to understand interference, diffraction and able to connect it to a few engineering applications.	3	S
CO3	Students should be able to explain the phenomena of polarization in electromagnetic waves and their production, Detection and analysis. They will also understand the operation and working principle of laser.	3	S
CO4	Students should be able to understand electromagnetic theory using maxwells equations, and its uses in various engineering application. They will also understand the difference between dia,para and ferromagnetic materials.	3	En
CO5	Students should be able to explain fundamentals of quantum mechanics and apply it to problems on bound states.	3	None

CO-PO Mapping for PH 3101

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	2	3	3	2	2	3	1	1	1	3	3	1	3
CO 2	2	2	3	2	3	3	1	2	1	1	1	3	3	2
CO 3	3	3	1	1	1	2	2	1	2	1	1	2	3	2
CO 4	1	1	3	2	2	2	2	1	2	3	2	2	2	1
CO 5	2	1	2	2	2	1	2	2	1	3	3	2	3	1
Avg.	2	1.8	2.4	2	2	2	2	1.4	1.4	1.8	2	2.4	2.4	1.8

CY3205	Title: Environmental Studies	L T P C 2 0 0 2
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	Creating awareness among engineering students about the importance of environment, the effect of technology on the environment and ecological balance is the prime aim of the course.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction to Environmental studies and Ecosystems	5
Multidisciplinary nature of environmental studies, Scope and importance, Need for public awareness. Concept, Structure and function of an ecosystem, Energy flow in an ecosystem: food chains, food webs and ecological pyramids. Examples of various ecosystems such as: Forest, Grassland, Desert, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)		
Unit II	Natural Resources: Renewable and Non- renewable resources	5
Land as a resource, land degradation, landslides (natural and man-induced), soil erosion and desertification. Forests and forest resources: Use and over-exploitation, deforestation. Impacts of deforestation, mining, dam building on environment and forests. Resettlement and rehabilitation of project affected persons; problems and concerns with examples. Water resources: Use and over-exploitation of surface and ground water, floods, drought, conflicts over water (international and inter-state). Foodresources:Worldfoodproblems,changescausedbyagricultureandovergrazing, effectsofmodernagriculture, fertilizer-pesticide problems with examples. Energy resources: Renewable and non renewable energy sources, use of alternate energy sources, growing energyneeds.		
Unit III	Biodiversity and Conservation	5
Levels of biological diversity: genetic, species and ecosystem diversity. Biogeographic zones of India. Ecosystem and biodiversity services. Biodiversity patterns and global biodiversity hot spots, India as a mega-biodiversity nation; Endangered and endemic species of India. Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.		
Unit IV	Environmental Pollution	4
Environmental pollution and its types. Causes, effects and control measures of :a) Air pollution b) Water pollution – freshwater and marine c) Soil pollution d) Noise pollution e) Thermal pollution Nuclear hazards and human health risks, Solid waste management: Control measures of urban and industrial waste.		
Unit V	Environmental Policies and Practices	5
Concept of sustainability and sustainable development. Water conservation and watershed management. Climate change,globalwarming,acidrain,ozonelayerdepletion.Disastermanagement:floods,earthquake,cyclonesand landslides. Wasteland reclamation. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation. Environment: rights and duties. Population growth. Field work Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of simple ecosystems-pond, river, hill slopes, etc.		
Text Books	1. Bharucha. E, Textbook of Environmental Studies for Undergraduate Courses	
Reference Books	1. KaushikAnubha,KaushikCP,PerspectivesinEnvironmentalStudies,NewAge Publication 2. Rajagopalan , Environmental Studies from Crisis to Cure, Oxford UniversityPress	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-7-2019	

Course Outcome for CY 3205

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to correlate the human population growth and its trend to the environmental degradation and develop the awareness about his/her role towards environmental protection and preventions.	2	Em
CO2	Students should be able to understand the solutions related to environmental problems related with the renewable& non-renewable resources.	2	S
CO3	Students should be able to understand the importance of ecosystem and biodiversity and the method of conservation of biological diversity.	2	S
CO4	Students should be able to understand different components of the environment and their function and the effects pollution on environment and should be able to understand the concept of sustainable development.	3	En
CO5	Students should be able to correlate the human population growth and its trend to the environmental degradation and develop the awareness about his/her role towards environmental protection and preventions.	3	None

CO-PO Mapping for CY3205

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	1	1	2	1	2	3	1	3	1	2	1	3	2
CO 2	2	1	1	1	2	1	2	1	3	2	3	2	2	3
CO 3	2	2	3	3	1	3	3	1	2	1	3	2	3	2
CO 4	2	3	1	1	2	3	1	3	3	3	3	3	1	1
CO 5	1	1	3	1	3	1	2	3	3	3	3	2	2	2
Avg.	2	1.6	1.8	1.6	1.8	2	2.2	1.8	2.8	2	2.8	2	2.2	2

ME3102	Title: Basic Mechanical Engineering	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To impart basic knowledge about various fields of Mechanical Engineering like Thermal Engineering, manufacturing, Mechanics and Strength of Materials.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Thermodynamics	6
Definition of thermodynamics, Energy and its forms, Enthalpy, Laws of thermodynamics, Heat engines, Heat pump, Refrigerator, Types of refrigerants, Introduction to Air-conditioning.		
Unit II	IC engines	6
Internal Combustion Engines:Classification and components of I.C. Engines, Working principle and comparison between 2 Stroke and 4 stroke engines, Difference between SI and CI engines.		
Unit III	Mechanics	8
Basic concept: Review of laws of motion, Concept of Free Body Diagrams, Types of supports and their reactions - requirements of stable equilibrium - Moments and Couples -Varignon's theorem - Equilibrium of Rigid bodies in two dimensions, Basic concepts of Friction and Trusses.		
Unit IV	Stress and Strain	8
Introduction, Normal &shear stresses, Stress-strain diagrams for ductile and brittle materials, Elastic constants, One dimensional loading of members of varying cross-section.		
Unit V	Introduction to Manufacturing	8
Introduction and classification of the manufacturing processes, Lathe and basic machining operations in lathe, Cutting tools, Cutting tool materials, Metal Forming:Forging and Sheet Metal operations, Joining Processes**:** Electric arc welding, Gas welding, Soldering and Brazing. Introduction to CNC machines		
Text Books	1. Basant Agarwal, Basic Mechanical Engineering, Wiley India, 2. Onkar Singh, S.S Bhavikatti, Introduction to Mechanical Engineering, New Age International 3. Hajra, Bose, Roy, Workshop Technology Vol 1 and 2, Media Promoters 4. D.S. Kumar, Mechanical Engineering, S.K. Kataria and Sons	
Reference Books	1. Irving H.Shames, Engineering Mechanics , P.H.I 2. Holman, J.P, Thermodynamics, Mc Graw Hill book Co. NY 3. Chapman W.A.J, Workshop Technology Part 1, Elsevier Science	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	06-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME 3102

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to understand application of the laws of thermodynamics to wide range of systems and aware about the basics of thermal engineering applications in Airconditioning and Refrigeration..	3	Em
CO2	Students should be able to know the working of IC engines and its working	2	S
CO3	Students should be able to know and apply the types of forces and concepts used to analyse force mechanisms	3	S
CO4	Students should be able to analyze and understand the Stress-strain diagrams and use of material	3	En
CO5	.Students should be able to understand the various machining processess.	2	Em

CO-PO Mapping for ME 3102

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	2	2	2	3	3	1	1	1	3	1	3	3
CO 2	3	2	2	2	2	2	1	2	1	1	1	2	2	2
CO 3	3	2	2	1	1	1	1	3	3	3	2	1	2	2
CO 4	3	3	1	1	2	2	2	2	2	3	3	1	2	1
CO 5	3	2	3	1	1	2	1	1	3	2	3	3	2	2
Avg.	3	2.2	2	1.4	1.6	2	1.6	1.8	2	2	2.4	1.6	2.2	2

CS3207	Title: Advance Computer Programming & Software	L T P C 4 0 0 4
Version No.	1.0	
Course Prerequisites	Nil	
Objective	This subject introduces the students with a deeper era of programming in C like Functions, Arrays, Pointer, Structure and Preprocessor Directive etc.	
Expected Outcome	On completion of subject the students will be able to apply learning Advance C, Device Driver Programming, Embedded C, Robotics Programming	
Unit No.	Unit Title	No. of Hrs (Per Unit)
Unit I	Pointers & Beyond Pointers	9
About Pointer [Declaration, Initialization and Access], Concept of memory maps, Concept of Process Control Block, Dangling Pointer, Orphan Objects, Dynamic Memory Allocation [malloc; calloc, realloc, free], Segmentation Fault, Core Dump and Illegal Memory Access, Pointer Arithmetic, Multiple Indirections.		
Unit II	Pointers & Arrays	9
Arrays, Understanding in depth 1-D, 2-D and 3-D array, Converting an array [1-D, 2-D, 3-D, n-D] to its pointer notation, Accessing array[1-D, 2-D, 3-D, n-D]with pointer, Creating Variable length array [1-D, 2-D], Limitation with array, Array of Pointers		
Unit III	Pointers & Functions, Arrays & Function	10
Understanding of function, Pointer pointing to function with different declarations, Accessing function with its pointer, Concept of Function returning function. Variable length arguments, Implementation of myPrintf and myScanf.Mixed Concepts:Array containing function(s), Array Containing array(s) [1-D, 2-D], Function returning array [1-D, 2-D].		
Unit IV	Making Header File and C Library	10
Understanding Preprocessor Directives and Compilation Process, Concept of Multiple Inclusion, Guard Macros, Role of Guard macros, Making Sample Header file, Understanding Concept of Linker, Creating Object code of function definition, Storing Object code in library, Setting path for Linker, Running code with user defined Header file and Library.		
Unit V	Tools and Software	10
Understanding Text Editors [vi and NANO], Understanding IDE (Integrated Development Environment) [Eclipse, Netbeans and .Net Framework], VB Code Editor in MS Excel, Introduction AutoCAD, Introduction Matlab, Introduction CATIA, Introduction FreePCB		
Text Books	1. "Mastering C" by KR Venugopal 2. "Let us C" by Y. kanetkar 3. "Programming in ANSI C" by E. Balagurusamy.	
Reference Books	1. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Pearson Education, 2. 2. Byron S Gottfried, " Programming with C", Schaum's Outlines Tata McGraw-Hill 3. 3. R.G. Dromey, "How to Solve it by Computer", Pearson Education	
Mode of Evaluation	Internal and External Examinations	
Recommended by Board of Studied on	07-06-2019	
Date of Approval by the Academic Council on	13-07-2019	

Course Code For CS 3207

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students will be able to understand about pointers and their usage in programming	3	Em
CO2	Student will be able to understand the usage of arrays in programming	2	S
CO3	Student will be able to use arrays,function pointer for programming	3	S
CO4	Student will be able to program using various C libraries	3	Em
CO5	Student will be able to know the various software tools	2	Em

CO-PO Mapping for CS3207

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO 1	3	2	2	1	1	1	1	1	1	2	1	1	2	1
CO 2	2	2	2	1	1	2	1	1	2	1	1	1	3	1
CO 3	2	3	2	1	1	1	1	1	1	2	1	2	3	2
CO 4	2	2	1	2	1	1	1	1	1	2	1	2	2	1
CO 5	3	2	1	2	2	1	1	1	1	2	1	2	3	1
Avg	3	2.2	1.6	1	1	1.2	1	1	1.2	1.8	1	1	2.6	1.2

PH3140	Title: Engineering Physics Lab	L T P C 0 0 2 1
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	The Objective of this course is to make the students gain practical knowledge to co- relate with the theoretical studies. To achieve perfectness in experimental skills and the study of practical applications will bring more confidence and ability to developand fabricate engineering and technical equipments.	

List of Experiments

1. To determine the wavelength of monochromatic light by Newton'sring.
2. To determine the wavelength of monochromatic light with the help of Fresnel'sbiprism.
3. To determine the focal length of two lenses by nodal slide and locate the position of cardinal points.
4. To determine the specific rotation of cane sugar solution using half shade polarimeter.
5. To determine the wavelength of spectral lines using plane transmission grating.
6. To determine the specific resistance of the material of given wire using Carey Foster's bridge.
7. To determine the variation of magnetic field along the axis of a current carrying coil and then to estimate the radius of the coil.
8. To verify Stefan's Law by electrical method.
9. To calibrate the given ammeter and voltmeter.
10. To study the Hall effects and determine Hall coefficient, cornier density and mobility of a given semiconductor material using Hall-effect setup.
11. To determine energy bank gap of a given semiconductor material.
12. To determine E.C.E. of copper using Tangent or Helmholtz galvanometer.
13. To draw hysteresis curve of a given sample of ferromagnetic material and from this to determine magnetic susceptibility and permeability of the given specimen.
14. To determine the balistic constant of a ballistic galvanometer.
15. To determine the viscosity of aliquid.

Mode of Evaluation	Internal and External Examinations
Recommendation byBoard of Studies on	13-06-2019
Date of approval by theAcademic Council	13-7-2019

Course Outcome for PH 3140

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to understand the process of performing the experiments on wavelength and focal length practically.	3	Em
CO2	Students should be able to verify the theoretical calculations with observed results in practical experiments.	3	S
CO3	Students should be able to Enhance the skills of using apparatus for verification of different laws.	3	S

CO-PO Mapping for PH3140

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	1	1	1	2	2	1	2	1	1	2	3	1	2	2
CO 2	2	3	1	2	3	1	3	2	1	3	1	2	1	2
CO 3	3	3	1	3	1	3	1	2	3	1	1	3	3	3
Avg	2	2.33	1	2.33	2	1.67	2	1.67	1.67	2	1.6	2	2	2.33

ME3140	Title: Workshop Practice	L T P C 0 0 32
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To know about the working methods adopted in various mechanicalshops along with tools and equipments for making a product. To understand the working of IC engines, Refrigerator, Air conditioner	

List of Experiments

1. Carpentry Shop:
   - I. Study of tools and operations and carpentry joints.
   - II. To prepare half-lap corner joint / mortise - tenon joint.
   - III. To make duster from wooden piece using carpentry tools

2. Fitting (Bench Working) Shop:
   - I. Study of tools and operations.
   - II. Step fitting of two metal plates using fitting tools.
   - III. Drilling and Tapping for generating hole and internal thread on a metal plate.

3. Black Smithy Shop:
   - I. Introduction of different Forging process.
   - II. Study of tools and operations such as upsetting, drawing down, punching, bending, fullering and swaging.
   - III. To forge chisel from MS rod.

4. Welding Shop:
   - I. Introduction of Welding and its classification.
   - II. Simple butt and Lap welded joints.

5. Sheet-metal Shop:
   - I. Introduction of various sheet metal operations.
   - II. Study of tools and operations.
   - III. To make geometrical shape like frustum, cone and prisms using GIsheet.

6. Machine Shop:
   - I. Introduction of Single point cutting tool, various machine tools.

Simple operations like Plane turning, Step turning and Taper turning.

Mode of Evaluation	Internal and External Examinations
Recommendation on by Board of Studies on	13-06-2019
Date of approval by the Academic Council	13-7-2019

Course Outcome for ME 3140

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students will be able to develop the ability to perform the various operations with the help of lathe machine and its tools	3	Em
CO2	Students will be able to develop the ability to perform the various operations using welding	3	S
CO3	Students will be able to develop the ability to perform the various operations using fitting tools	3	S
CO4	Students will be able to develop the ability to perform the various operations on wood using carpenty tools	3	s
CO5	Students will be able to develop the ability to perform the various operations using Sheet metal and blacksmithy tools	3	s

CO-PO Mapping for ME3140

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO 1	3	2	1	1	2	1	1	1	1	1	1	2	3	1
CO 2	2	2	2	1	2	1	1	1	1	1	1	2	3	2
CO 3	2	2	1	1	1	1	1	1	1	1	1	1	3	1
CO 4	3	2	2	1	1	1	1	1	1	1	1	2	3	2
CO 5	3	2	1	1	2	1	1	1	1	1	1	2	3	1
Avg	2.6	2	1.4	1	1.6	1	1	1	1	1	1	1.8	3	1.4

CE3101	Title: Disaster Management	L T P C 2 0 0 2
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	The course is intended to provide a general concept in the dimensions of disasters caused by nature beyond the human control as well as the disasters and environmental hazards induced by human activities with emphasis on disaster preparedness, response and recovery.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit: 1	Introduction on Disaster	5
Different Types of Disaster : A) Natural Disaster: such as Flood, Cyclone, Earthquakes, Landslides etc B) Man-made Disaster: such as Fire, Industrial Pollution, Nuclear Disaster, Biological Disasters, Accidents (Air, Sea, Rail and Road), Structural failures(Building and Bridge), War and Terrorism etc. Causes, effects and practical examples for all disasters.		
Unit II	Risk and Vulnerability Analysis	4
Risk: Its concept and analysis 2. Risk Reduction 3. Vulnerability: Its concept and analysis 4. Strategic Development for Vulnerability Reduction		
Unit III	Disaster Preparedness	5
Disaster Preparedness: Concept and Nature . Disaster Preparedness Plan Prediction, Early Warnings and Safety MeasuresofDisaster. Role of Information, Education, Communication, and Training, . Role ofGovernment, International and NGO Bodies. . Role of IT in Disaster Preparedness. Role of Engineers on Disaster Management.		
Unit IV	Disaster Response	5
Introduction Disaster Response Plan Communication, Participation, and Activation of Emergency Preparedness Plan Search, Rescue, Evacuation and Logistic Management Role of Government, International and NGOBodies Psychological Response and Management (Trauma, Stress, Rumor and Panic). Relief and Recovery Medical Health Response to Different Disasters		
Unit V	Rehabilitation, Reconstruction and Recovery	5
Reconstruction and Rehabilitation as a Means of Development. Damage Assessment Post Disaster effects and Remedial Measures. Creation of Long-term Job Opportunities and Livelihood Options, Disaster Resistant House Construction Sanitation and Hygiene Education and Awareness, Dealing with Victims' Psychology, Long-term Counter Disaster Planning Role of EducationalInstitute.		
Text Books	1. Bhattacharya, Disaster Science and Management, McGraw Hill Education Pvt. Ltd.	
Reference Books	1. Dr. Mrinalini Pandey, Disaster Management, Wiley India Pvt.Ltd. 2. JagbirSingh,DisasterManagement:FutureChallengesandOpportunities,KW Publishers Pvt.Ltd.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-7-2019	

Course Outcome for CE3101

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to understand the basic concepts of disasters and its relationships with development.	1	Em
CO2	Students should be able to understand the approaches of Disaster Risk Reduction (DRR) and the relationship between vulnerability, disasters, disaster prevention and risk reduction.	1	S
CO3	Students should be able to understand the Medical and Psycho-Social Response to Disasters.	1	S
CO4	Students should be able to prevent and control Public Health consequences of Disasters.	2	En
CO5	Students should have awareness of Disaster Risk Management institutional processes in India.	2	None

CO-PO Mapping for CE3101

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO 1	2	1	1	2	1	2	2	1	2	1	1	1	1	2
CO 2	1	2	2	1	2	2	2	1	2	1	1	2	1	2
CO 3	2	2	1	2	1	2	2	1	2	1	1	2	1	2
CO 4	1	2	1	1	1	2	2	1	2	1	1	2	1	2
CO 5	2	1	1	1	1	3	1	1	2	1	1	2	1	2
Avg	1.6	1.6	1.2	1.4	1.2	2.2	1.8	1	2	1	1	1.8	1	2

SEMESTER 3

ME3308	Title: Strength of Materials	L T P C 2 2 0 3
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To know conceptual applications of principles of mechanics on rigid and deformable bodies	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Stress and Strain	6
Simple Stresses and Strains – Tension, Compression and Shear Stresses - Hooke's Law - Compound Stresses - Thermal Stresses – Compound Bars. Two-Dimensional System, Stress at a Point on a Plane, Principal Stresses and Principal Planes, Mohr's Circle.		
Unit II	Shear Force and Bending Moment	5
Shear Force and Bending Moment Diagrams for Beams and Simple Frames - Theory of Simple Bending, Bending Stress Distribution at Sections.		
Unit III	Torsion	6
Theory of Simple Torsion – Torsional Rigidity – Composite Shafts in Series and Parallel. Thin Cylinders and Shells – Thick Cylinders, Helical and Leaf Springs.		
Unit IV	Deflection of Beams	5
Derivation of Differential Equation of Moment Curvature Relation, Deflection of Simple Beams by Double Integration Method		
Unit V	Columns and Struts	4
Buckling of Column, Slenderness Ratio, Euler's Buckling Load for Slender Column, EffectiveLength for Different End Condition. Introduction to Strain Energy, Stresses due to Impact and Concept of Virtual Work.		
Text Books	1 R K Bansal,Strength of Material, Kindle Edition. 2 R.K.Rajput,Strength of Materials, S.Chand.	
Reference Books	1. G.H.Ryder, Strength of Materials, Macmillan 2. P.K. Nag,Fundamentals of Strength of Materials, Wiley India 3. E. P. Popov, Engineering Mechanics of Solids, Prentice Hall. 4. P.Boresi , Advanced Mechanics of Materials, Wiley	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome For ME 3308

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to know and understand various mechanical properties of materials for real time applications.	2	Em
CO2	Students should be able to understand the behaviour of trusses under loads and beams under the application of shear force and bending moment.	3	S
CO3	Students should be able to understand the behaviour of shafts under torsion and behavior of cylinder and springs under various loads.	3	S
CO4	Students should be able to understand the behaviour of beams under stresses and apply the knowledge through numerical problems.	3	En
CO5	Students should be able to understand the behaviour of columns and struts and estimate effective length under different conditions.	3	None

CO-PO Mapping for ME 3308

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO 1	3	2	2	2	1	1	1	1	1	2	1	2	3	2
CO 2	3	3	2	2	1	1	1	1	2	1	1	2	3	2
CO 3	2	3	2	3	1	1	1	1	1	2	1	2	2	2
CO 4	3	2	2	3	1	2	1	1	1	2	1	2	3	2
CO 5	3	2	2	2	1	1	1	1	1	2	1	2	3	2
Avg	2.8	2.4	2	2.4	1	1.2	1	1	1.2	1.8	1	2	2.8	2

ME3302	Title: Materials Science	L T P C 2 0 0 2
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To understand the various properties of materials	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction to Material Science	7
Introduction: Importance of materials. Historical perspective, Brief review of modern and atomic concepts in Physics and Chemistry. Atomic models, Periodic table, Chemical bonding. Crystallography and Imperfections: Concept of unit cell space lattice, Bravais lattices, common crystal structures, Atomic packing factor and density. Miller indices. X-ray crystallography techniques. Imperfections, Defects and Dislocations in solids.		
Unit II	Magnetic properties, Electric properties and Diffusion of Solid	7
Concept of magnetism - Di, para, Ferro Hysteresis. Soft and hard magnetic materials, Magnetic storages. Energy band concept of conductors, insulators and semi-conductors. Intrinsic and extrinsic semi-conductors. P-n junction and transistors. Basic devices and their applications. Diffusion mechanism, Steady-state and Non-steady-state diffusion, Factors influencing diffusion.		
Unit III	Phase Diagram and Equilibrium Diagram, Metals and Alloys	7
Phase and Equilibrium Diagrams, Phase rules, Iron-carbon equilibrium diagram, Various types of carbon steels, alloy steels and cast irons, its properties and uses. Non-ferrous metals, Brass, Bronze, bearing materials, their properties and uses. Aluminum alloys.		
Unit IV	Heat Treatment and corrosion	7
Various types of heat treatment such as Annealing, Normalizing, Quenching, Tempering and Case hardening. Time Temperature Transformation (TTT) diagrams. Corrosion and its effects. Preventive methods.		
Unit V	Powder Metallurgy, Ceramics and Plastics	8
Introduction, Process detail, Sintering, Secondary and finishing operations. Ceramics: Structure types and properties and applications of ceramics. Mechanical/Electrical behavior and processing of Ceramics. Various types of plastics and their applications, Mechanical behavior and processing of plastics.		
Text Books	1. V. Raghavan ,Materials Science and Engineering, Prentice HallIndia 2. R. Srinivasan ,Engineering Materials and Metallurgy, Tata McGrawHill	
Reference Books	1. E. P. Degarmo ,Materials and Processes in Manufacturing, WileyIndia 2. Budinski and Budinski ,Engineering Materials: properties and selection,Prentice HallIndia 3.William D. Callister, Material Science and Engineering an Introduction, John Wiley andSons	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	06-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME 3302

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student should be able to understand the fundamental knowledge about engineering materials, its modern and atomic concepts, properties, imperfections and applications.	2	Em
CO2	Student should be able to learn about the magnetic and electric properties and diffusion of solids.	2	S
CO3	Student should be able to learn the fundamental knowledge about Iron-Carbon Equilibrium Phase Diagram and alloys.	2	S
CO4	Student should be able to learn the different heat treatment processes and corrosion, its causes, effects and prevention.	2	En
CO5	Student should be able to learn the fundamental knowledge about powder metallurgy, composites, ceramics and plastics.	2	None

CO-PO Mapping for ME 3302

CourseOutcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2,Low-1,Notrelated-0)												ProgramSpecific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1	1	2	1	1	1	1	1	2	3	2
CO2	3	3	2	2	1	2	2	1	2	2	1	2	3	2
CO3	3	2	2	1	1	2	1	1	1	1	2	2	2	2
CO4	2	3	2	2	1	2	1	1	1	1	2	2	3	2
CO5	3	3	2	1	1	1	1	1	1	1	1	2	3	2
Avg	2.8	2.8	1.8	2.4	1	1.8	1.2	1	1.2	1.2	1.2	2	2..8	2

ME3306	Title: Thermal Engineering	L T P C 3 2 0 4
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To make the students aware of thermal concepts and their application	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Basic Thermodynamics	8
Basic concepts, laws of thermodynamics, steady flow energy equation and its application, Carnot cycle, Reversed Carnot cycle, Performance. Clausius inequality. Concept of entropy, T-S diagram, T-ds Equations - entropy change for different processes, principle of increase in entropy, Availability and Irreversibility analysis for open and closed systems. Maxwell relations, heat capacities relations, Energy equation, Joule-Thomson experiment, Clausius-Clapeyron equation.		
Unit II	Pure Substances and Power Cycles	8
Formation of Steam and its thermodynamic properties, Determination of dryness fraction, Steam Table and Mollier Chart, Ideal and actual Rankine, reheat and regenerative cycle. Air Standard Cycles - Otto, Diesel, Dual, Brayton. IC Engine performance characteristics and heat balance.		
Unit III	Gas Turbine and Steam Turbine	8
Gas Turbine: open and closed cycle. Performance and its improvement, Regenerative, Intercooled and Reheat cycle. Steam Turbine: Types, Impulse and reaction principles, Velocity diagrams, Work done and efficiency, Multi-staging, compounding and governing.		
Unit IV	Steam Nozzle and Boilers	6
Steam nozzle: Types and Shapes of nozzles Flow of steam through nozzles, Critical pressure ratio, Variation of mass flow rate with pressure ratio, Effect of friction, Meta-stable flow. Boilers: Types, comparison. Mountings and Accessories, Performance calculations, Draught, Boiler trial.		
Unit V	Compressors	6
Classification and comparison, Reciprocating compressors-working principle, work of compression - with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency. Multistage air compressor with Intercooling, Centrifugal compressors- working principle, work of compression.		
Text Books	1. R.K.Rajput ,Thermal Engineering, LaxmiPublication 2. Mahesh. M. Rathore ,Thermal Engineering, Tata McGrawHill,	
Reference Books	1. Y. Cengel and M. Boles ,Thermodynamics - An Engineering Approach,TMH 2. P.L.Ballaney ,Thermal Engineering, KhannaPublishers 3. J.P. Holman, Thermodynamics, Tata McGrawHill 4.P.K Nag ,Engineering Thermodynamics, Tata McGraw Hill New Delhi	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME 3306

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student should be able to understand the basic concepts of thermodynamics and know the thermodynamic relations	2	Em
CO2	Student should be able to understand the formation of steam and calculate the efficiency of different power cycles.	3	S
CO3	Student should be able to understand the functioning of steam power plant, gas power plant and their major components.	3	S
CO4	Student should be able to analyze the performance of boilers and flow through nozzles used in existing thermal system.	3	S
CO5	Student should be able to know concepts of compressor and its working	3	S

CO-PO Mapping for ME 3306

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	2	1	1	1	1	1	1	1	2	1	2	2
CO 2	2	3	2	1	2	1	1	1	1	1	1	1	3	2
CO 3	3	3	2	1	1	2	1	1	1	1	1	1	3	2
CO 4	3	3	2	1	2	1	1	1	1	1	1	2	3	2
CO 5	3	3	2	1	1	1	1	1	1	1	2	1	3	2
Avg	2.8	2.8	2	1	1.4	1.2	1	1	1	1	1.4	1.2	2.8	2

ME3304	Title: Fluid Mechanics and Machines	L T P C 3 2 0 4
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To understand the mechanics of fluid and to study and their applications in flow through pipes and hydraulic machines	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Fluid Properties and Statics	7
Introduction: Dimensions and units, physical properties of fluids- specific gravity, viscosity, surface tension, vapor pressure and their influence on fluid motion, atmospheric gauge and vacuum pressure, measurement of pressure - Piezometer, U tube and differential manometers. Fluid statics: Pressure-density-height relationship, pressure on plane and curved surfaces, centre of pressure, buoyancy, stability of immersed and floating bodies, fluid masses subjected to linear acceleration and uniform rotation about an axis.		
Unit II	Fluid Kinematic and Dynamics	7
Fluid kinematics: stream line, path line and streak lines and stream tube, classification of flows, equation of continuity for one dimensional and 3D dimensional flow, circulation, stream function and velocity potential, source, sink and doublet. Fluid dynamics: surface and body forces – Euler's and Bernoulli's equations for flow along a stream line, measurement of flow, momentum equation and its application on force on pipe bend.		
Unit III	Internal and External Flows	6
Flow through tubes and plates -Shear stress and velocity distributions, Navier-stokes equations of fluid motion, Reynolds transport theorem, Reynolds experiment - Darcy-Weisbach equation, Minor losses in pipes - pipes in series and pipes in parallel, total energy line, hydraulic gradient line.		
Unit IV	Turbo Machinery and Hydraulic Turbines	8
Basics of turbo machinery: hydrodynamic force of jets on stationary and moving -flat, inclined, and curved vanes, velocity diagrams, work done and efficiency, flow over radial vanes. Hydraulic Turbines: classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine - working proportions, work done, efficiencies, draft tube – theory, functions and efficiency.		
Unit V	Pumps & Compressors	8
Centrifugal pumps: classification, working, work done, Manometric head, losses and efficiencies, specific speed, performance characteristic curves, NPSH. Reciprocating pumps: Components and Principles, Classification, discharge, work done, power requirement. Compressors: classification & types, rotary and centrifugal - single stage and multistage, construction details and performance characteristics		
Text Books	1. P.N. Modi and S.M. Seth ,Hydraulics and Fluid Mechanics, Standard BookHouse 2. R K Bansal ,Fluid Mechanics and Hydraulic Machines, Laxmipublications.	
Reference Books	1. Robert.Fox,AlanT.McDonald,PhilipJ.Pritchard,IntroductiontoFluid Mechanics, JohnWiley 2. C.S.P.Ojha,R.BerndtssonandP.N.Chandramouli,FluidMechanicsand Machinery, Oxford UniversityPress 3. S.K. and Biswas ,Introduction of Fluid Mechanics and Fluid Machines,TMH,	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	06-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome For ME 3304

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to understand about basics of fluid mechanics and concepts related to fluid statics.	2	Em
CO2	Students should be able to clear concepts related to fluid kinematics and fluid dynamics and clear concepts related to basic equations used in fluid dynamics also student able to solve application problems of fluid dynamics.	2	S
CO3	Students should be able to understand the mechanics of fluid and to study and their applications in flow through pipes and External Flows.	2	S
CO4	Students should be able to understand the properties and characteristics of basics of turbomachinery and Hydraulic turbines. Also able to solve application problems.	2	En
CO5	Students should be able to understand the properties and characteristics of a fluid and also analyze the performance of pumps and Compressors.	2	None

CO-PO Mapping for ME 3304

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2,Low-1,Notrelated-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	1	1	1	1	1	1	1	1	3	1
CO2	3	2	1	1	1	1	1	1	2	2	1	1	3	1
CO3	3	3	3	1	1	1	1	1	1	1	1	2	3	3
CO4	3	3	3	1	1	1	1	1	1	1	1	2	3	3
CO5	3	2	1	1	1	1	1	1	1	1	1	1	3	3
Avg	3	2.2	1.8	1	1	1	1	1	1.2	1.2	1	1.4	3	2.2

ME3307	Title: Computer Aided Machine Drawing	L T P C 1 0 33
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To read and interpret the drawings correctly for production of components accurately and development of sketching ability which strengthens effective engineering communication.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction	10
Introduction to Machine Drawing, Conventions and symbols, limits, fits and Tolerances, Drawing different types of screw threads and threaded fasteners. Drawing of different types of riveted joints and weldedjoints		
Unit II	Assembly Drawings	20
Free hand sketching of machine component like socket spigot joint, connecting rod, Piston Drawing machine component- Plummer block, Knuckle Joint, Shaft Coupling. Drawing Machine components like V Belt Pulley, Machine Vice, Screw Jack.		
Unit III	Drawing using Computer software	18
Starting AutoCAD, command window, status bar, Coordinate system, creating basic object using different 2D commands. Creating drawings with dimensions. Rules of isometric drawing, working in isometric drawing, Setting the isometric grid and snap. Working in 3D, 3D Coordinate modifying visuals styles of solid. Creating 3D Designs: working with predefined solid primitive, manipulating, modifying 3D profile and models, filleting and chamfering solid models. Prepare production drawing of a machine part in AutoCAD.		
Text Books	1. P.S. Gill, Machine Drawing , Kataria and Sons,Ludhiana. 2. Er. R. K. Dhawan ,A Textbook of Machine Drawing , S Chandpublication	
Reference Books	1. GR Nagpal , Machine Drawing, Khanna Publishers, NewDelhi. 2. ND Bhatt, Machine Drawing, Charotar Book Depot. 3. Sadhu Singh and P.L. Shah ,Fundamentals of Machine Drawing,PHI	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	06-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome For ME 3307

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student should be able to know about various Conventions and symbols and study limits, fits and Tolerances he should be able to Draw different types of screw threads, threaded fasteners, riveted joints and welded joints.	3	Em
CO2	Student should be able to understand and draw the part and assembly drawing of Machine Components.	4	S
CO3	Student should be able to understand the basic commands of AutoCAD software and draw 2D and 3D drawing on this software.	4	S,Em

CO-PO Mapping for ME 3307

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2,Low-1,Notrelated-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	2	1	1	1	1	1	1	2	2	1
CO2	3	3	3	2	2	1	1	1	2	2	1	2	2	2
CO3	3	2	3	2	3	1	1	1	1	1	1	3	2	2
Avg	3	2.3	3	2	2.3	1	1	1	1.3	1.3	1	2.3	2	1.6

ME3344	Title: Strength of Materials Lab	L T P C 0 0 2 1
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To know the methods to determine various properties of material.	
Expected Outcome	Students will able to understand the method to find properties of material.	

List of Experiments

1. Verification of principle of moment: Bell crank lever.
2. Determination of hardness of metals: Brinell / Vicker / Rockwell hardness test
3. Determination of impact strength of metals: Izod / Charpy impact test
4. Determination of tensile strength and percentage elongation of the given metal specimen
5. Determination of compressive strength of the given specimen.
6. Determination of torsional strength and modulus of rigidity for metals
7. Determination of spring index of the given helical coil spring
8. Experiment on deflection of beam
9. Performing creep test of the given specimen
10. To perform the buckling of column under different end conditions.

Mode of Evaluation	Internal and External Examinations
Recommendation by Board of Studies on	13-06-2019
Date of approval by the Academic Council	13-07-2019

Course Outcome for ME 3344

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to calculate the hardness of different materials used in mechanical engineering	3	Em
CO2	Students should be able to perform different tests like impact test, torsion test, tensile and compressive tests to check the mechanical properties of materials	3	S
CO3	Students should be able to check the deflection in beams and perform different tests like creep test and buckling of column	3	S

CO-PO Mapping for ME 3344

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2,Low-1,Notrelated-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	2	1	1	1	1	1	1	1	2	3	2
CO2	2	3	2	3	1	1	1	1	1	1	1	2	3	2
CO3	3	3	2	3	1	1	1	1	1	1	1	2	3	2
Avg	2.3	3	2	2.6	1	1	1	1	1	1	1	2	3	2

ME3341	Title: Material Science Lab	L T P C 0 0 21
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To understand structure-property correlation, phase diagrams and properties of the solid based on the phase diagram.	

List of Experiments

1. Making a plastic pattern using injection moulding.
2. Specimen preparation for microstructuralexaminationusingcutting,grinding,polishing,etching.
3. Grain size determination of a given specimen.
4. Comparativestudyofmicrostructuresofdifferentgivenspecimens(mildsteel,graycastiron,brass, copper etc.)
5. Annealingandnormalizingofthegivenspecimenandcomparisonofhardnessbeforeandafter treatment.
6. Hardeningand temperingofthegivenspecimenandcomparisonofhardnessbeforeandafter the treatment.
7. Casehardeningofthegivenspecimenusinggasflameandcomparisonofhardnessbeforeandafter treatment.
8. To determine the energy band gap of a given semi conductor material
9. TomeasureandcomparethevariationofResistance/Resistivityofmetalandsemiconductorwith temperature
10. Study of microstructure of welded component and identification ofHAZ.

Mode of Evaluation	Internal and External Examinations
Recommendation by Board of Studies on	06-06-2019
Date of approval by the Academic Council	13-07-2019

Course Outcome for ME 3341

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student should be able to learn and identify the different properties possessed by the engineering materials.	3	Em
CO2	Student should be able to learn and perform the microscopic examination using metallurgical microscope and specimen polishing machine.	3	S
CO3	Student should be able to learn and perform the different heat treatment processes and calculate the difference in hardness before and after heat treatment.	3	S

CO-PO Mapping for ME 3341

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate-2,Low-1, Notrelated-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	1	1	1	1	1	1	1	3	3	2
CO2	3	2	2	3	1	1	1	1	1	1	1	2	3	2
CO3	2	2	2	3	1	1	1	1	1	1	1	2	3	2
Avg	2.3	2	2	2.6	1	1	1	1	1	1	1	2.3	3	2

ME 3342	Title: Fluid Mechanics and Machines Lab	L T P C 0 0 21
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To learn methods to measure the discharge and head losses. To learn the working and performance characteristics of hydraulic turbines	

List of Experiments

1. To determine the Coefficient of Discharge of Venturi meter and Orificemeter
2. To measure the frictional losses in pipes of different sizes.
3. To determine the coefficient of loss of head due to sudden contraction.
4. To verify the Bernoulli's equation.
5. To find the coefficient of impact of jet on a flat circular and hemispherical vane.
6. To find out the efficiency of the Pelton wheel turbine on different loads.
7. To find out the efficiency of the Francis turbine on different loads.
8. To conduct a test at various heads of given single stage centrifugal pump and to find its efficiency.
9. To conduct a test at various heads of given reciprocating pump and calculate its efficiency.
10. To determine the coefficient of discharge of an orifice of a given shape.

Mode of Evaluation	Internal and External Examinations
Recommendation by Board of Studies on	06-06-2019
Date of approval by the Academic Council	13-07-2019

Course Outcome for ME 3342

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to learn practical espects of fluid Mechanics like pressure measurement, losses in fluid flow or due to shape change and apply them in designing and problem solving	3	Em
CO2	Students should be able to know the practical aspects of various turbines such as kaplan, francis and apply in designing process	3	S
CO3	Students should be able to know the practical aspects of various pumps such as reciprocating pump and apply in designing process	3	S

CO-PO Mapping for ME 3342

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2,Low-1,Notrelated-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	1	1	2	1	1	1	1	2	2	3	3
CO2	3	3	2	1	1	2	1	1	1	1	2	2	3	2
CO3	3	3	2	1	1	2	1	1	1	1	2	2	2	3
Avg	2.67	2.67	2	1	1	2	1	1	1	1	2	2	2.67	2.67

ME3343	Title: Thermal Engineering Lab	L T P C 0 0 2 1
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To understand the working of boilers and engines	

List of Experiments

1. Study and sketch of Lancashire boiler model (Fire tube boiler).
2. Study and sketch of Babcock and Wilcox boiler model (Water tube boiler).
3. Study and compare the working of two stroke petrol engine& two stroke diesel engine model.
4. Study the working of steam engine.
5. Study and compare the working of four stroke SI engine& CI engine.
6. To determine the brake horse power, volumetric efficiency of a single cylinder, four stroke water cooled, Vertical diesel engine.
7. To determine the IHP of IC engine by Morse Test.
8. To prepare the heat balance sheet for IC engine Test rig
9. To determine the free air delivered and volumetric efficiency of reciprocating multi stage air compressor.
10. To Study the working and function of various boiler mountings and accessories.

Mode of Evaluation	Internal and External Examinations
Recommendation by Board of Studies on	13-06-2019
Date of approval by the Academic Council	13-07-2019

Course Outcome for ME3343

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student should understand the working and determine the performance parameters of IC engines.	3	Em
CO2	Student should understand the construction and working of different boilers	2	S
CO3	Student should able to analyse the performance parameters of reciprocating compressor.	3	S

CO-PO Mapping for ME3343

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate-2,Low-1,Notrelated-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	1	1	1	2	1	2	2	2	2
CO2	2	2	2	2	2	1	1	1	2	1	1	2	2	2
CO3	3	2	2	2	2	2	1	1	1	1	2	2	3	2
Avg	2.67	2	2	2	2	1.33	1	1	1.67	1	1.67	2	2.33	2

ME3404	Title: Heat Transfer	L T P C 2 2 0 3
Version No.	1.0	
Course Prerequisites	ME3306	
Objectives	To understand the mechanisms of heat transfer under steady and transient conditions and to know about various modes of heat transfer	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Conduction Heat Transfer	5
Introduction to Heat Transfer, Different Modes of Heat Transfer, Effect of Temperature on Thermal Conductivity of Materials, Introduction to Combined Heat Transfer Mechanism. Conduction: General Equation in Different Coordinates, One Dimensional Steady State Heat Conduction (Plane and Composite Systems), Introduction to Conduction with Internal Heat Generation.		
Unit II	Fins and Transient Heat Conduction	4
Extended Surfaces, Transient Heat Conduction (Lumped Analysis and Use Of Heisler's Charts).		
Unit III	Convection Heat Transfer	5
Boundary Layer Concept, Forced Convection: External Flow (Flow Over Plates, Cylinders and Spheres). Internal Flow (Entrance Effects). Free Convection: Flow Over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres.		
Unit IV	Phase Change Heat Transfer and Heat Exchangers	5
Nusselt's Theory of Condensation, Regimes of Pool Boiling, Correlations in Boiling and Condensation. Heat Exchanger Types - Overall Heat Transfer Coefficient – Fouling Factors. LMTD and NTU Methods		
Unit V	Thermal Radiation	5
Basic Radiation Concepts; Radiation Properties of Surfaces; Black Body Radiation Laws; Shape Factor; Black-Body Radiation Exchange; Radiation Exchange Between Non-Black Bodies in an Enclosure; Infinite Parallel Planes, Radiation Shields.		
Text Books	1. Heat Transfer, P.K. Nag, Tata McGraw Hill, New Delhi. 2. R. C. Sachdeva , Fundamentals of Engineering Heat and Mass transfer, New Age International Publishers.	
Reference Books	1. Frank P. Incropera and David P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley and Sons. 2. S.P. Venkateshan , Heat Transfer, , Ane Books, New Delhi. 3. C.P. Kothandaraman, Fundamentals of Heat and Mass Transfer, New Age International, New Delhi. 4. R. Yadav , Heat and Mass Transfer, Central Publishing House. 5. J.P. Holman , Heat and Mass Transfer, Tata McGraw Hill.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME3404

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student should be able to Understand the modes of heat transfer and its governing laws and also acquire skills to calculate heat transfer in steady state conditions	2	Em
CO2	Student should be able to calculate the heat transfer in transient conditions and understand the importance of extended surface.	2	S
CO3	Student should be able to understand convective heat transfer and find the heat transfer coefficient in varying conditions.	2	S
CO4	Student should be able to analyse heat exchangers and understand the phase change heat transfer.	2	S
CO5	Student should be able to understand the various principles involved in the radiation heat transfer and find the heat transfer rate	2	S

Mapping for ME3404

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	3	2	3	2	3	1	1	1	1	1	1	2	3	3
CO 2	3	3	2	2	2	1	1	1	1	1	1	2	3	1
CO 3	3	2	2	2	2	2	1	1	2	1	2	2	3	1
CO 4	3	3	3	2	2	1	2	1	1	2	1	2	3	1
CO 5	3	2	3	2	3	2	1	1	2	1	2	2	3	2
Avg	3	2.4	2.6	2	2.4	1.4	1.2	1	1.4	1.2	1.4	2	3	1.6

ME3402	Title: Theory of Machines	L T P C 3 2 0 4
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To understand the motion, transmission of the motion and the forces responsible for the motion.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Kinematics	8
Links types, Kinematics pairs classification, Constraints types, Degree of Freedom, Grubler's equation, linkage mechanisms, inversions of four bar linkage, slider crank chain and double slider crank chain. Velocity in Mechanisms: Velocity of point in mechanism, relative velocity method instantaneous point in mechanism, Kennedy's theorem, instantaneous center method		
Unit II	Friction Devices: Clutches, Brakes and Dynamometers	7
Classification of clutches, torque transmission capacity, considerations for uniform wear and uniform pressure theory, single plate and multi-plate clutch, centrifugal clutch, Classification of brakes, Braking effect, Analysis of Brakes, Classification of Dynamometers.		
Unit III	Flywheel	7
Significance of flywheel, Turning moment and crank effort diagrams for reciprocating machines, coefficient of fluctuation of speed and energy, Limiting velocity of flywheel, Design of flywheels for engines and punching machines		
Unit IV	Governors	7
Necessity of governor, Classification of Governors, Working principle of centrifugal governors, Concept of control force, Control force diagram, Stability of governor, Condition for stability, Concept of isochronism, Sensitivity of governor, Characteristics of governors, Hunting of governors.		
Unit V	Gyroscope and Cams	7
Principle of gyroscope, Definition of axes, active and reactive couples; Roll, Yaw and Pitch motions; Gyroscopic effect in a rotor, two wheelers, Four wheelers, ship and airplane. Introduction to cams and follower.		
Text Books	1. S S Rattan, Theory of Machines, TataMcGraw-Hill. 2. J.Uicker , Gordon R Penstock and J.E. Shigley ,Theory of Machinesand Mechanisms, Oxford publication.	
Reference Books	1. R L Norton ,Kinematics and Dynamics of Machinery, TataMcGraw-Hill. 2. Kenneth J Waldron , Gary L Kinzel, Kinematics, Dynamics and Designof Machinery, Wileypublication. 3. A G Ambekar ,Mechanism and Machine Theory,PHI 4. Martin, Kinematics and Dynamics of Machines, McGrawHill.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	06-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME 3402

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student should be able to understand the basic components used in the making of machines and mechanism along with the exploration of their interrelation to give them motion	2	Em
CO2	Student should be able to understand the use of clutches, brakes and dynamometers in vehicles and applying the knowledge gained through numerical problems	3	S
CO3	Student should be able to understand the application of flywheel in machines and applying the knowledge gained through numerical problems	3	S
CO4	Student should be able to understand the application of governors in machines and applying the knowledge gained through numerical problems	3	S
CO5	Student should be able to understand the concept of gyroscope and cams in machines & aircrafts and applying the knowledge gained through numerical problems	3	S

CO-PO Mapping for ME 3402

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2,Low-1,Notrelated-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	1	1	1	1	1	1	1	2	3	3
CO2	3	3	1	1	1	1	1	1	1	1	1	1	2	2
CO3	3	3	2	1	1	1	1	1	1	1	1	2	3	2
CO4	3	3	1	2	1	1	1	1	1	1	1	2	2	3
CO5	3	3	2	1	1	1	1	1	1	1	1	1	3	3
Avg	3	3	1.6	1.2	1	1	1	1	1	1	1	1.6	2.6	2.6

ME3403	Title: Production Technology	L T P C 3 0 03
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To provide knowledge of various manufacturing processes like casting, joining, forming and metal cutting.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Casting Process	8
Introduction to Casting, Steps involved in casting, advantages, limitations and applications of casting process. Pattern types, allowances for pattern, pattern materials. Moulding methods and processes-materials, equipment, Moulding sand ingredients, essential requirements, sand preparation and control, cores and core making. Gating system. Casting Processes: sand castings die casting, centrifugal casting, investment casting, shell moulding, defects in castings.		
Unit II	Welding	7
Basic joining processes, welding classifications, gas welding and it types, arc welding and its types, resistance welding and its types, thermit welding,. soldering, brazing and their application. welding defects.		
Unit III	Forming Processes I	7
Metal Forming: Elastic and plastic deformation, concept of strain hardening, hot and cold working processes. Forging: Introduction, classification of forging, forging defects, swaging, wire and tube drawing. Rolling: Introduction, classification of rolling , rolling defects.		
Unit IV	Forming Processes II	7
Extrusion: Classification, extrusion equipment, load displacement, characteristics; different extrusion dies, extrusion defects, tube extrusion. Sheet Metal Working : Applications of sheet formed products. Shearing mechanism. Processes - blanking, piercing, punching, trimming etc. Forming processes - bending, cup drawing, coining, embossing etc, punch and die clearances, Progressive, compound and combination dies.		
Unit V	Metal Cutting and Machine Tools	7
Cutting parameters, Cutting tool geometry; Tool signature, Tool materials and cutting fluids, Tool Life, Power required for machining; Types of Machine tools-Lathe, Shaper, Planer, Milling and Drilling Machines		
Text Books	1. PNRao,ManufacturingTechnology(Vol.IandII),TataMcGrawHill,NewDelhi 2. P.C.Sharma,ATextBookofProductionTechnology,SChandandCompanyLtd.	
Reference Books	1. Ghosh and Mallik ,Manufacturing Science ,East West Press Pvt. Ltd., NewDelhi 2. SKalpakjianandSRSchmidt,ManufacturingEngineeringandTechnology,Addision Wesley Longman, NewDelhi. 3. R K Jain ,Production Technology, Khanna Publishers, NewDelhi.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	06-6-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME 3403

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student should be able to Know about the understanding of casting process	2	Em
CO2	Student should be able to Know about the applications of various types of welding processes.	2	S
CO3	Student should be able to Know about the principles of forming processes,	2	S
CO4	Student should be able to Know about the various concept of sheet metal operation	2	S
CO5	Student should be able to learn about the conventional and modern machine tools, understanding of metal cutting principles and mechanism, and cutting tool geometry of single point and multipoint cutting tool	2	S

CO-PO Mapping for ME 3403

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2,Low-1,Notrelated-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1	1	1	1	1	2	1	1	3	2	2
CO2	2	2	1	1	2	2	1	1	2	1	1	2	2	2
CO3	2	2	1	1	1	1	1	1	1	1	2	2	2	3
CO4	2	3	1	1	1	1	1	1	1	1	2	2	3	3
CO5	3	3	1	1	2	2	2	1	1	1	2	3	2	2
Avg	2.4	2.6	1	1	1.4	1.4	1.2	1	1.4	1	1.6	2.4	2.2	2.4

EE3404	Title: Electrical Machines	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites	NIL	
Objectives	To understand concept ,working, operation, maintenance of single phase transformer, three phase transformer, DC motor and generator	
Unit No.	Unit Title	No. of hours (per unit)
Unit I	Transformers	7
Principle, Construction of Core, E.M.F. Equation, Winding and Tank, Cooling, Operation, Testing of Single Phase Transformer, Equivalent Circuit, Phasor Diagram, Parameters Determination, P.U Representation of Parameters, Regulation, Losses and Efficiency, Separation of Iron Losses, Parallel Operation, All-Day Efficiency, Sumner's Test, Specifications of Transformer, Maintenance of Transformer, Difference Between Power Transformer and Distribution Transformer. Principle, Construction, Comparison with Two Winding Transformers, Applications.		
Unit II	AC Motors	7
Construction, Features, Production of Torque, Phasor Diagram, Equivalent Circuit, Performance Analysis, Torque -Slip Characteristics, Running, Light and Blocked Rotor Test, Load Test on 3-Ph I.M. Three Phase Synchronous Motor: Construction, Principle of Operation, Equivalent Circuit, Torque, Power Developed, Starting, V-Curve, Hunting-Causes, Effects &Reduction, Synchronous Condenser Applications.		
Unit III	DC Generators	6
Principle & Construction of D.C. Generator, Simplex Lap, Wave Winding, E.M.F. Equation, Types, Voltage Build Up, Armature Reaction, Compensating Winding, Function of Commutator, Methods of Improving Commutation, Load Characteristics, Parallel Operation		
Unit IV	DC Motors	7
Principle of DC Motors, Function of Commutator in DC Motors, Torque and Output Power Equations, Load Characteristics, Losses, Starting, Starters, Speed Control, Braking, Testing ,Swinburne Test, Hopkinson Test, Ward Leonard Method, Principle, Operation and Applications		
Unit V	Special Motors	6
Universal Motor, Single Phase A.C. Series Compensated Motor, Single Phase & 3-Phase Induction Motor, Stepper Motors (Working & Principle), Gear Motor, Servo Motors(Working And Principle),.Applications		
Text Books	1. I.J. Nagrath and D.P. Kothari ,Electrical Machines:, TMH, New Delhi 2. P.S. Bhimbra , Electrical Machines, , Khanna Pub. Delhi.	
Reference Books	1. Ashfaq Husain ,Electrical Machines, Dhanpat Rai & company 2. A.S Langsdorf ,Theory of alternating current machinery, , TMH 3. Fitzerald & Kingsley ,Electric Machinery, MGH	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for EE 3404

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student should be able to know about constructional features, parts, Working principle of transformer, DC machines.	2	Em
CO2	Student should be able to know about alternator,three phase induction and single phase induction motor.	2	S
CO3	Student should gain knowledge on electrical analog,transfer function and signal charecteristics.	2	S
CO4	Student should be able to know about time response analysis of second order systems.	2	S
CO5	Student should know about frequency response anaysis and draw bode and polar plots.	2	S

CO-PO Mapping for EE 3404

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	2	1	3	2	2	3	1	2	3	2	1	2	2
CO 2	2	1	3	2	1	1	1	2	1	2	2	2	2	1
CO 3	2	1	2	3	2	1	2	1	1	1	1	2	2	2
CO 4	2	2	3	2	1	1	1	2	2	2	2	2	2	2
CO 5	2	2	2	1	2	2	2	2	3	1	2	2	2	2
Avg	2	1.6	2.2	2.2	1.6	1.4	1.8	1.6	1.8	1.8	1.8	1.8	2	1.8

ME3443	Title: Heat Transfer lab	L T P C 0 0 2 1
Version No.	1.0	
Course Prerequisites	NIL	
Objectives	To understand the methods to determine the thermal conductivity and heat transfer rate in different conditions.	

List of Experiments

1. To determine the effectiveness of a heat exchanger in parallel flow condition and draw the graph between temperature and length.
2. To determine the effectiveness of a heat exchanger in counter flow condition and draw the graph between temperature and length.
3. To determine the thermal conductivity of given specimen by using guarded hot plate apparatus
4. To find out the nature of the temperature distribution in case of a heat pipe and also comparing its heat transfer rate with a stainless steel and copper pipe.
5. To determine the boiling heat transfer coefficient in two phase heat transfer system.
6. To determine the value of emissivity of a given surface experimentally.
7. To experimentally determine the heat transfer coefficient from the outer side of an electrically heated vertical tube in air during natural convection.
8. To measure the heat transfer rate through the given composite wall.
9. To measure the critical radius of insulation of the given specimen.

Mode of Evaluation	Internal and External Examinations
Recommendation by Board of Studies on	13-06-2019
Date of approval by the Academic Council	13-07-2019

Course Outcome For ME3443

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student should be able to understand the conduction heat transfer in steady conditions	2	Em
CO2	Student should be able to understand and analysis of heat exchanger	3	S
CO3	Student should be able to analyze the convection heat transfer	3	S

PO Mapping for ME3443

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	0	1	1	2	0	0	0	1	1	3	3	2
CO 2	3	2	2	3	1	2	2	0	3	1	1	2	2	0
CO 3	3	3	2	3	2	2	1	3	2	2	2	2	3	2
Avg	3	2.3	1.3	2.3	1.33	2	1	1	1.6	1	1.6	2.33	2.67	1.3

ME3441	Title: Theory of Machines lab	L T P C 0 0 21
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To understand the various mechanism and to analyses governors, gyroscope and brakes	

List of Experiments

1. To study various types of kinematic links, pairs, chains and mechanisms
2. Performance of spring controlled governors
3. Analysis of gyroscopic effect using gyroscope
4. To study various types of gear trains- simple, compound reverted, epicyclic and differential
5. Tostudydynamicforceanalysisof4-barmechanismandslidercrankmechanism(analyticalmethods)
6. Design of Flywheel for IC engine and Punch press.
7. Measurement of critical speed of a rotating shaft of given diameter.
8. To study the various types of dynamometers
9. To perform the experiment of balancing of rotating parts and find the unbalanced couple and forces
10. To study various types of cam and follower arrangement
11. Tofindoutcriticalspeedexperimentallyandtocomparethewhirlingspeedofashaft with theoretical values.

Mode of Evaluation	Internal and External Examinations
Recommendation by Board of Studies on	06-06-2019
Date of approval by the Academic Council	13-07-2019

Course Outcome for ME 3441

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student should be able to understand the principles of working of various links, mechanisms and dynamometers.	2	Em
CO2	Student should be able to determine performance parameters of gyroscope, governors.	4	S
CO3	Student should be know the concept of balancing of masses and determine the critical speed of shafts in loading conditions	3	S

CO-PO Mapping for ME 3441

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	1	1	1	1	1	1	1	1	1	3	3	2
CO 2	3	2	1	2	2	1	1	1	1	1	1	2	3	2
CO 3	2	3	1	2	2	1	1	1	1	1	1	3	2	2
Avg	2.67	2.67	1	1.67	1.67	1	1	1	1	1	1	2.67	2.67	2

ME3442	Title: Production Technology Lab	L T P C 0 0 21
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To perform various manufacturing processes experimentally.	

List of Experiments

1. Thread cutting in lathe machine
2. Drilling and Boring operation in Lathe machine
3. Basic experiment on forging like making a hook/Sbend
4. Exercises on wire drawing androlling
5. Press work experiment such as blanking/piercing, washer, makingetc.
6. Tube bending with the use of sand and on tube bendingm/c.
7. Pattern making with proper allowance for desiredcasting.
8. Making a mould and performcasting.
9. Gear cutting on millingmachine
10. Slot cutting on shapermachine

Mode of Evaluation	Internal and External Examinations
Recommendation by Board of Studies on	06-06-2019
Date of approval by the Academic Council	13-07-2019

Course Outcome for ME 3442

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student should be able to acquire skills to make a pattern and perform simple casting process.	3	Em
CO2	Student should be able to learn about the preparation of various jobs in various manufacturing machines such as Milling, Shaper, Wire Drawing and Rolling.	3	S
CO3	The student should be able to perform machining operations in a lathe machine.	3	S

CO-PO Mapping for ME 3442

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate-2,Low-1,Notrelated-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	2	1	1	1	1	1	2	2	3	2
CO2	3	2	2	1	2	1	1	1	1	1	1	2	2	2
CO3	3	3	2	2	2	2	1	1	1	1	2	3	2	2
Avg	3	2.3	2	1.3	2	1.3	1	1	1	1	1.67	2.3	2.3	2

SEMESTER 5

ME3501	Title: Machine Design I	L T P C 3 2 04
Version No.	1.0	
Course Prerequisites	ME3308/ME3301	
Objectives	To understand procedure of designing a machine component and develop an ability to apply the theories of failure for design of different mechanical components.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Design Principles	6
Design Process, Design Considerations, Standards and Codes, Use of Preferred Series, Factor of Safety, Service Factor, Stress Concentration - Causes and Remedies, Theories of Failure. Fluctuating Stresses, Fatigue Failures, S-N Curve, Endurance Limit, Notch Sensitivity, Endurance Strength Modifying Factors, Design for Finite and Infinite Life, Cumulative Damage in Fatigue Failure, Soderberg, Gerber, Goodman, Modified Goodman Diagrams, Fatigue Design of Components under Combined Stresses.		
Unit II	Design of Shaft, Key and Couplings	8
Design of Shafts Based on Strength, Torsional Rigidity and Lateral Rigidity, A.S.M.E. Code for Shaft Design, Design of Keys and Splines. Design of Flange Coupling and Flexible Bushed Pin Coupling.		
Unit III	Design of Joints	7
Design of Cotter Joint, Knuckle Joint, Welding Symbols, Strength of Butt, Parallel and Transverse Fillet Welds, Design of Welded Joints: Axially Loaded Unsymmetrical Welded Joints, Eccentric Load in Plane of Welds, Welded Joints Subjected to Bending and Torsional Moments.		
Unit IV	Design of Screw Jack	8
Forms of Threads, Multiple Start Screws, Torque Analysis and Design of Power Screws with Square and Trapezoidal Threads, Self-Locking Screw, Collar Friction Torque, Stresses in Power Screws, Design of a C-Clamp. Design of Screw Jack.		
Unit V	Design of Springs	7
Types, Applications and Materials for Springs, Stress and Deflection Equations for Helical Compression Springs, Style of Ends, Design of Helical Compression and Tension Springs, Springs in Series and Parallel, Concentric Helical Springs. Helical Torsion Spring, Surge in Springs. Multi-Leaf Springs.		
Text Books	1. V.B. Bhandari, Design of Machine Elements, Tata McGrawHill Publication Co. Ltd. 2. R.S.Khurmi,A Text Book of Machine Design, S ChandPublishers.	
Reference Books	1. P.H.Black and O. Eugene Adams ,Machine Design, McGraw Hill Book Co.Inc. 2. Willium C. Orthwein, Machine Components Design, West Publishing Co. and Jaico PublicationsHouse. 3. A.S.Hall, A.R.Holowenko and H.G. Laughlin, Theory and Problems of Machine Design, Schaum's OutlineSeries 4. J.E. Shigley and C.R. Mischke, Mechanical Engineering Design, McGraw Hill Publication Co.Ltd	
Mode of Evaluation	Internal and External Examinations(Use of design data book is allowed during the examination)	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME 3501

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student should be able to gain basic concept of machine design and find out the machine component life under the application of various types of load conditions.	3	Em
CO2	Student should be able to design the Shaft, key and coupling under different type of Stress conditions.	2	S
CO3	Student should be able to know the basics of Lever and different types of joints used in mechanical engineering and study how to design them for practical application.	2	S
CO4	Student should be able to Understand the various parts and types of screw jack and design their components according to load value given.	2	S
CO5	Student should be able to understand about different types of spring used in machines and the design procedure adopted for different types of spring.	3	S

CO-PO Mapping for ME 3501

Course Outcom es	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	2	3	3	3	2	1	1	1	1	1	1	3	3	3
CO 2	3	2	3	2	2	1	1	1	1	1	1	2	3	2
CO 3	2	3	3	3	2	1	1	1	1	1	1	2	3	3
CO 4	3	2	2	2	2	1	1	1	1	1	1	2	2	2
CO 5	3	2	3	3	1	1	1	1	1	1	1	2	3	3
Avg	2.6	2.6	2.8	2.6	1.8	1	1	1	1	1	1	2.2	2.8	2.6

ME3503	Title: Operation Research	L T P C 2 2 03
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To learn decision making for the real life problems by appropriate measures and apply scientific techniques in industry.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction to Linear Programming	6
Scope and Application of Operations Research. Linear Programming Problem: Introduction, Requirement of LP, Basic Assumptions, Formulation of LP, General Statement of LP; Solution Techniques of LP using Graphical Methods and Analytical Methods: Simplex, Big M and Two Phase, Sensitivity Analysis, Primal and Dual Problems.		
Unit II	Transportation Model	5
Transportation and Assignment Model: Linear Form, Solution Methods: North West Corner Method, Least Cost Method, Vogel's Approximation Method. Degeneracy in Transportation, Modified Distribution Method, Unbalanced Problems and Profit Maximization Problems. Transshipment Problems. Assignment Problems and Travelling Sales Man Problem.		
Unit III	Queuing Theory	5
Queuing Theory: Basics and Elements of Queuing Theory, Classification of Queuing Models, Kendall's Notation, Operating Characteristics, Examples of M/M/1:∞/FCFA		
Unit IV	PERT and CPM	4
Introduction to PERT and CPM, Critical Path Calculation, Float Calculation and its Importance. Cost Reduction by Crashing of Activity.		
Unit V	Game Theory	4
Game Theory: Introduction and Characteristics, Two Person Zero Sum Games, Pure Strategy. Dominance Theory, Mixed Strategies (2x2, Mx2), Algebraic and Graphical Methods.		
Text Books	1. P.K Gupta and D.S Hira, Operation Research, S. ChandPublishers. 2. Hamdy Taha, Operations Research: An Introduction,Pearson	
Reference Books	1. H N Wagner, Operations Research, Prenticehall. 2. Ronald Rardin, Optimization in Operations Research, Pearson EducationInc. 3. R. Paneerselvam, Operations Research, Prentice Hall of India Pvt.Ltd. 4. N D Vohra , Quantitative Techniques in Management, TataMcGraw-Hill 5. SDSharma,OperationsResearch-Theory,MethodsandApplications,KedarNathRam NathPublishers.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME 3503

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student should be able to understand the principles of decision making through linear programming and applying the learnings though numerical problems	3	S
CO2	Student should be able to understand the principles of decision making through transportation & assignment models and applying the learnings though numerical problems.	2	S
CO3	Student should be able to understand the principles of decision making through queuing theory & waiting line models and applying the learnings though numerical problems.	2	S
CO4	Student should be able to understand the principles of decision making through network diagrams such as PERT & CPM and applying the learnings though numerical problems.	2	S
CO5	Student should be able to understand the principles of decision making through Game Strategy and applying the learnings though numerical problems.	2	S

CO-PO Mapping for ME 3503

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	3	2	2	2	1	1	1	1	1	1	2	1	2	2
CO 2	2	3	3	2	1	1	1	1	1	1	2	1	3	2
CO 3	2	2	2	2	2	1	1	1	2	1	2	2	2	2
CO 4	2	2	2	2	1	1	1	1	1	1	2	1	2	2
CO 5	3	3	2	2	2	1	1	1	2	1	2	2	3	2
Avg	2.4	2.4	2.2	2	1.4	1	1	1	1.4	1	2	1.4	2.4	2

ME3504	Title: Vehicle Technology	L T P C 2 2 0 3
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	This course is designed to give the students an understanding of all the parts of the vehicle and its various power systems (IC Engine, Electric, Hybrid)	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Vehicle Fundamentals	7
Types of Vehicle, Description of a Vehicle, Classification of Chassis and Frame, Vehicle Movement Description, Vehicle Resistance, Tractive Effort, Vehicle Power Plant and Transmission Characteristics, Vehicle Performance.		
Unit II	IC Engine Power Systems	8
IC Engine Classification and Parts, Valve Timing Diagram, Rotary Engines, Stratified Charge Engine. Fuels, Dopes, Additives, Ignition Delay, Knocking, Detonation and its Control. Fuel Supply Systems in S.I. Engine and C.I Engine., Introduction and Working of Carburetor, Fuel Pump and Fuel Injector, Types of Nozzles and Fuel Spray Patterns, MPFI System, CRDI. Necessity and Types of Cooling and Lubrication Systems.		
Unit III	Transmission and Control System	7
Steering System: Introduction, General Arrangements of Steering Systems, Steering Gears, Steering Ratio, Reversibility, Steering Geometry, Steering Arms, Drag Link, and Power Steering. Clutches. Torque Converters. Over Drive and Free Wheel, Universal Joint. Differential Gear Mechanism of Rear Axle. Automatic Transmission, Steering and Front Axle. Front Axle: Introduction, Construction, Types of Front Axles, Stub Axles. Braking System: Classification of Brakes, Mechanical Brakes, Hydraulics Brakes, Power Brakes and Brake Effectiveness. Anti-Lock Braking System(ABS).		
Unit IV	Suspension and Electrical Systems	7
Requirement and Types of Suspension System and Wheels. Requirement and Types of Tyres, Tread Patterns, Factors Affecting Tyre Life,. Wheel Balancing, Wheel Alignments. Brief Description of Battery and Starting Motor, Dynamo and Alternators, Ignition System: Introduction, Coil Ignition System, Spark Plugs, Firing Order, Ignition Timing. DTSI. Charging and Lighting Systems in Vehicles.		
Unit V	Electric Vehicle	7
Configuration of Electric Vehicles, Electric Propulsion Systems (Permanent Magnet BLDC Motor, SRM Motor).Performance of Electric Vehicles-Traction Motor Characteristics, Tractive Effort and Transmission Requirement, Vehicle Performance, Tractive Effort in Normal Driving, Energy Consumption. Concept of Hybrid Electric Drive Trains.		
Text Books	1. Kripal Singh, Automobile Engineering , StandardPublisher 2. V. Ganeshan, I.C Engine,TMH 3. MehradEhsani,YiminGao,SebastienGay,ModernElectric,HybridElectricandFuel Cell Vehicles: Fundamentals Theory and design, CRCPress.	
Reference Books	1. Crouse, Automotive Mechanics,TMH 2. Ferguson , I C Engines, WileyIndia 3. Hietner, Automotive Engineering, CBSPublisher 4. R. Yadav, I.C Engine, Central Publishing House,Allahabad	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome For ME 3504

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student should be able to understand the Vehicle's Fundamentals	2	Em
CO2	Student should be able to learn about the applications of various IC Engine Power System	2	S
CO3	Student should be able to understand the working principles of Transmission and understanding of Control System	2	S
CO4	Student should be able to know about the various concept of Suspension and Electrical System	2	S
CO5	Student should be able to get understanding of various Electric Vehicle	2	S

CO-PO Mapping for ME 3504

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	3	1	2	1	1	0	1	1	1	3	3	2
CO 2	2	2	3	1	1	3	1	0	1	2	1	3	2	1
CO 3	2	1	2	1	2	2	2	0	2	1	1	2	2	1
CO 4	3	2	2	1	3	1	1	0	1	1	1	2	2	1
CO 5	3	3	3	2	1	2	2	1	2	1	1	3	3	2
Avg	2.6	2	2.6	1.2	1.8	1.8	1.4	1	1.4	1.2	1	2.6	2.4	1.6

ME3505	Title: Refrigeration and Air Conditioning	L T P C 2 2 03
Version No.	1.0	
Course Prerequisites	ME3306	
Objectives	The main objective of this course is to provide an insight how thermodynamic principles are applied in the refrigeration and air-conditioning.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Air Refrigeration System	5
Introduction to Refrigeration, Basic Definition, Air Refrigeration: Air Refrigeration Cycles-Reverse Carnot cycle, Bell-Coleman Cycle Analysis, Air Refrigeration Systems (ARS)- Types, Analysis, Merits and Demerits. Dry Air Rated Temperature(DART) and Comparison of Various ARS		
Unit II	Vapor Compression Refrigeration System	5
Vapor Compression Refrigeration System, Working and Analysis, Use of Charts, Limitations, Multistage Vapor Compression Refrigeration Systems, Flash Gas Removal, Flash Intercooling and Water Intercooling. Cascade System. Refrigeration System Equipment –Compressors, Condensers, Expansion Devices and Evaporators.		
Unit III	Vapor Absorption Systems	4
Vapor Absorption Refrigeration Systems, Water-Ammonia Systems, Water-Lithium Bromide System, Rectifier and Analyzer. Refrigerants: Classification, Designation, Desirable Properties of Refrigerants, Global Warming due to Refrigerants and Advances in Refrigerants.		
Unit IV	Air Conditioning	5
Psychrometry: Psychrometric Properties, Psychrometric Chart, Representation of Psychrometric Processes on the Chart, Heating /Cooling with Humidification and Dehumidification, Adiabatic Dehumidification, Mixing Processes. Introduction to Air Conditioning: Requirements of Comfort Air Conditioning, Thermodynamics of Human Body, Comfort Chart, Effective Temperature. Industrial Air Conditioning.		
Unit V	Design of Air Conditioning Systems	5
Cooling Load Calculations in Air Conditioning: Concept of Bypass Factor, Sensible Heat Factor, Apparatus Dew Point, Room Sensible Heat Factor (RSHF), Gross Sensible Heat Factor (GSHF), Different Heating and Cooling Loads, Problems. Design of Air Conditioning Systems: All Fresh Air, Re-Circulated Air with Bypassed Air, Types of Air Conditioning Systems.		
Text Books	1. C.P. Arora, Refrigeration and Air Conditioning , Tata McGraw Hill, NewDelhi. 2. S.C.Arora,andS.Domkundwar,ACourseinRefrigerationandAirconditioning, Dhanpat Rai and Sons, NewDelhi.	
Reference Books	1. V.K Jain., Refrigeration and Air Conditioning, S Chand and Company, NewDelhi. 2. W.S. Stocker , Refrigeration and Air conditioning, , McGraw Hill, NewDelhi. 3. Roy J Dossat, Principles of Refrigeration,Pearsons. 4. Manohar Prasad , Refrigeration and Airconditioning, New AgeInternational.	
Mode of Evaluation	Internal and External Examinations (Use of Refrigeration and Airconditioning Tables and Chart is allowed during the examination)	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME3505

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to develop understanding about basics of Refrigeration and clear concepts related to ideal parameters of refrigeration.	3	Em
CO2	Students should be able to clear concepts related to vapor compression refrigeration system.	3	S
CO3	Students should be able to understand the basics of vapor absorption system and its application	2	S
CO4	Students should be able to understand the properties and characteristics of basics of air conditioning.	3	S
CO5	Students should be able to solve cooling load calculations and also able to design of air conditioning system by solving practical problems	3	S

CO-PO Mapping for ME3505

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	3	2	2	1	1	1	1	1	1	1	1	2	3	1
CO 2	3	2	2	2	1	1	2	1	1	1	1	2	3	2
CO 3	3	3	3	2	1	3	3	1	2	2	1	3	2	2
CO 4	3	3	3	3	2	2	1	1	1	1	2	3	3	1
CO 5	3	3	3	3	2	2	2	1	1	2	1	3	3	2
Avg	3	2.6	2.6	2.2	1.4	1.4	1.8	1	1.2	1.4	1.2	2.6	2.8	1.6

ME3541	Title: Vehicle Technology Lab	L T P C 0 0 21
Version No.	1.0	
Course Prerequisites	NIL	
Objectives	To understand the various systems in vehicle	

List of Experiments

1. To Study the Working of Fuel Supply System and Ignition Systems of an Engine Based Automobile.
2. To Study the Constructional Details, Working Principles and Operation of Clutch and Gear Box of an Automobile.
3. To Study the Constructional Details, Working Principles and Operation of Suspension and Steering System of an Automobile.
4. To Study the Latest Fuel Standards and Emission Norms applied for Vehicles in India.
5. To Study the Constructional Details, Working Principles and Operation of Engine Cooling and Lubricating System of an Automobile.
6. ToStudytheConstructional Details,WorkingPrinciplesandOperationofBrakingSystemofanAutomobile.
7. To Study Tyre Types and its Tread Pattern.
8. To Study the Lighting and Charging Systems in aVehicle
9. To Study the Constructional Details, Working Principles and Operation of Automotive Emission/Pollution ControlSystem.
10. To Understand the Procedure of Wheel Balancing and WheelAlignment.

Mode of Evaluation	Internal and External Examinations
Recommendation by Board of Studies on	13-06-2019
Date of approval by the Academic Council	13-07-2019

Course Outcome For ME 3541

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student should be able to understand the working of various systems in a vehicle	2	Em
CO2	Student should be able to Know about the types of tyres and tread patterns	3	S
CO3	Student should be able Learn about the fuel standards and emission norms	2	S

CO-PO Mapping for ME 3541

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	1	1	1	2	1	1	1	1	1	2	2	2
CO 2	3	2	1	3	1	2	1	1	1	1	1	2	1	1
CO 3	2	2	2	2	1	1	2	1	1	1	1	1	1	2
Avg	2.6	2.3	1.3	2	1	1.6	1.3	1	1	1	1	1.6	1.3	1.3

ME3542	Title: Refrigeration and Air Conditioning Lab	L T P C 0 0 21
Version No.	1.0	
Course Prerequisites	NIL	
Objectives	The objective of teaching this Lab to the students is to make them understand how refrigerators, air-conditioner work	
List of Experiments		
1. To Calculate Coefficient of Performance (COP) of Air Conditioning TestRig. 2. To Study the Evaporators used in RefrigeratingSystem. 3. To Study the Expansion Devices used in RefrigeratingSystem. 4. To Study and Sketch of Refrigeration TestRig. 5. To Study and Sketch of Window Type AirConditioner. 6. To Study Basic Components of Air ConditioningSystem. 7. To Study the Working Principle of Steam Jet RefrigerationSystem. 8. ToDrawtheCoolingandDehumidificationProcessonPsychometricChartand toDetermineLatent, Sensible and Total HeatLoss. 9. Study of Procedure for Leak Detection, Evaluation and Charging ofRefrigerants. 10. To Study the Constructional Details of Hermetically Sealed CompressorUnit.		
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME3542

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student should be able to acquire the knowledge about the working of basic components of refrigeration system and study the performance calculations.	2	Em
CO2	Student should be able to acquire the knowledge about the basic components of air conditioning and investigate the effect of psychometric processes on the performance of air conditioners	3	S
CO3	Student should be able to acquire the knowledge of psychometric processes	3	S

CO-PO Mapping for ME3542

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	2	1	2	1	1	1	1	1	1	2	3	1
CO 2	3	2	2	2	1	1	1	1	1	1	1	2	3	2
CO 3	2	3	3	2	1	1	1	1	1	1	1	1	2	2
Avg	2.67	2.3	2.3	1.6	1.3	1	1	1	1	1	1	1.67	2.67	1.67

SEMESTER 6

ME3601	Title: Machine Design II	L T P C 3 2 04
Version No.	1.0	
Course Prerequisites	ME3501	
Objectives	To understand the design process and modes of failure of mechanical components like gears, bearings and engine parts	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Spur Gears	7
Tooth Forms, System of Gear Teeth, Contact Ratio, Standard Proportions of Gear Systems, Interference in Involute Gears, Backlash, Selection of Gear Materials, Gear Manufacturing Methods, Design Considerations, Beam Strength of Gear Tooth, Dynamic Tooth Load, Wear Strength of Gear Tooth, Failure of Gear Tooth, Design of Spur Gears, AGMA and Indian Standards.		
Unit II	Helical and Bevel Gears	7
Helical and Bevel Gears: Types of Helical and Bevel Gears, Terminology, Virtual Number of Teeth, and Force Analysis of Helical and Straight Bevel Gear. Design of Helical snd Straight Bevel Gear based on Beam Strength, Wear Strength and Estimation of Effective Load based on Velocity Factor (Barth Factor) and Buckingham's Equation. Mountings of Bevel Gear. Worm and Worm Gear Terminology and Proportions of Worm and Worm Gears, Force Analysis of Worm Gear Drives, Friction in Worm Gears, Efficiency of Worm Gears, Design of Worm Gearing System.		
Unit III	Rolling Contact Bearing	7
Types of Rolling Contact Bearings, Static and Dynamic Load Carrying Capacities, Stribeck's Equation, Equivalent Bearing Load, Load- Life Relationship, Selection of Bearing Life Selection of Rolling Contact Bearings from Manufacturer's Catalog, Design for Cyclic Loads and Speed, Bearing with Probability of Survival other than 90% Taper Roller Bearing: Force Analysis and Selection Criteria. (Theoretical Treatment Only)		
Unit IV	Sliding Contact Bearing	7
Types, Selection of Bearing, Plain Journal Bearing, Hydrodynamic Lubrication, Properties and Materials, Lubricants and Lubrication, Hydrodynamic Journal Bearing, Heat Generation, Design of Journal Bearing, Thrust Bearing-Pivot and Collar Bearing, Hydrodynamic Thrust Bearing,		
Unit V	IC Engine Parts	8
Selection of Type of IC Engine, General Design Considerations, Design of Cylinder and Cylinder Head; Design of Piston, Piston Ring and Gudgeon Pin; Design of Connecting Rod; Design of Crankshaft.		
Text Books	1. V.B. Bhandari , Design of Machine Elements, Tata McGraw Hill Publication Co.Ltd. 2. R.S.Khurmi, A Text Book of Machine Design, S ChandPublishers.	
Reference Books	1. P.H.Black and O. Eugene Adams ,Machine Design, McGraw Hill Book Co.Inc. 2. Willium C. Orthwein, Machine Components Design, West Publishing Co. and Jaico PublicationsHouse. 3. A.S.Hall, A.R.Holowenko and H.G. Laughlin, Theory and Problems of Machine Design, Schaum's OutlineSeries 4. J.E.ShigleyandC.R.Mischke,MechanicalEngineeringDesign,McGrawHillPublicationCo. Ltd	
Mode of Evaluation	Internal and External Examinations (Use of design data book is allowed during the examination)	

Recommendation by Board of Studies on	13-06-2019
Date of approval by the Academic Council	13-07-2019

Course Outcome for ME3601

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student should be able to understand about spur gear and design procedure adopted for spur gear under various load conditions.	2	Em
CO2	Student should be able to understand about Helical and Bevel gear and design the helical and bevel gear under various load conditions.	2	S
CO3	Student should be able to know about Rolling contact bearing and design various types of rolling contact bearing for industrial applications.	2	S
CO4	Student should be able to understand about sliding contact bearing and design various types of sliding contact bearing for industrial applications.	2	S
CO5	Student should be able to know about the general design considerations and selection of Type of IC Engine and Design IC engine Components.	3	S

CO-PO Mapping for ME3601

Course Outcom es	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	3	2	3	2	1	1	1	1	1	1	1	2	3	2
CO 2	3	2	3	2	1	1	1	1	1	1	1	2	2	2
CO 3	3	3	3	3	2	2	1	1	2	1	2	2	3	2
CO 4	2	2	3	3	1	1	1	1	1	2	1	2	3	2
CO 5	2	2	2	2	2	2	1	1	2	1	2	2	3	2
Avg	2.6	2.2	2.8	2.4	1.4	1.4	1	1	1.4	1.2	1.4	2	2.8	2

ME3603	Title: Measurement and Metrology	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To acquire knowledge on different mechanical measurement instruments.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction	7
Errors in measurements, measuring instruments sensitivity, stability, range, accuracy and precision-static and dynamic response- repeatability, systematic, source of error, statistical analysis of data, regression analysis, correction, calibration. Estimation of uncertainty, introduction to limits, fits, tolerances and is standards, tolerance analysis in manufacturing and assembly. Standards of linear measurement, line and end standards. Interchange ability and standardization. Measurement system analysis.		
Unit II	Linear and Angular Measurements	8
Linear measuring instruments: evolution, types, classification, limit gauges, gauge design, terminology, procedure, concepts of interchange ability and selective assembly, angular measuring instruments, types, bevel protractor clinometers angle gauges, spirit levels sine bar, angle alignment telescope, autocollimator, applications. Measurement of pressure: gravitational, directing acting, elastic and indirect type pressure transducers. Measurement of very low pressures (high vacuum). Strain measurement: types of strain gauges and their working, strain gauge circuits, temperature compensation. Strain rosettes, calibration.		
Unit III	Power Flow and Temperature Measurement	7
Flow measurement: pitot tube, venturimeter, hot wire anemometry, laser doppler velocimetry, rotameter Temperature measurement: thermometers, bimetallic thermocouples, thermistors and pyrometers. Measurements of force, torque: different types of load cells, elastic transducers, pneumatic & hydraulic systems. Seismic instruments. Measurements of acceleration, and vibration: accelerometers vibration pickups and decibel meters, vibrometers.		
Unit IV	Metrology	7
Comparators: sigma, Johansson's Microkrator. Limit gauges classification, Taylor's principle of gauge design Basic concept of lasers, advantages of lasers, laser interferometers – types, DC and AC lasers interferometer, applications, straightness, alignment. Basic concept of CMM, types of CMM, constructional features, probes, accessories, software, applications, basic concepts of machine vision system, element, applications.		
Unit V	Form Measurement	7
Principles and methods of straightness, flatness measurement, thread measurement, gear measurement, surface finish measurement, roundness measurement, applications.		
Text Books	1. Jain, RK ,Engineering Metrology, KhannaPublishers 2. Jain, R.K., Mechanical Measurement, KhannaPublishers	
Reference Books	1. Gupta SC , Engineering Metrology, Dhanpat RaiPublications 2. Beckwith ,Mechanical Measurements,Pearson 3. Bentley, Principles of Measurement Systems,Pearson. 4. Bewoor and Kulkarni ,Metrology of Measurements, McGrawHill.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome For ME3603

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to develop the inspection of engineering parts with various precision instruments.	2	Em
CO2	Students should be able to the basic use Principles of measuring instruments and gauges and their uses.	2	S
CO3	Students should be able to the significance of measurement system, errors, transducers, intermediate modifying and terminating devices.	2	S
CO4	Students should be able to the advances in Metrology such as use of CMM, Laser, Machine Vision System for Metrology etc.	2	S
CO5	Students should be able to the Inspection of spur gear, thread elements and Evaluation and inspection of surface roughness.	2	S

CO-PO Mapping for ME3603

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	2	2	3	2	3	1	1	1	1	1	1	2	2	2
CO 2	3	3	2	3	3	1	1	1	1	1	1	2	2	2
CO 3	3	2	3	2	3	2	1	1	2	1	1	2	3	3
CO 4	3	2	2	2	3	1	1	1	1	1	1	2	2	2
CO 5	2	2	3	3	3	2	1	1	2	1	1	3	2	3
Avg	2.6	2.2	2.6	2.2	3	1.4	1	1	1.4	1	1	2.2	2.,2	2.4

MT3603	Title: Mechatronics	L T P C 3 0 03
Version No.	1.0	
Course Prerequisites	EC3101	
Objectives	The objective of teaching this subject to the students is to make them understand the use of electronic devices to implement automation in industries.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction	6
Introduction to Mechatronic Systems, Mechatronics in Products, Measurement Systems, Control Systems, Traditional Design and Mechatronics Design. Principles and Strategies of Automation.		
Unit II	Pneumatic and Hydraulic Systems	7
Introduction to Pneumatic and Hydraulic System, Pneumatic and Hydraulic Actuators, Mechanical Actuators, Electrical Actuators. Block Diagram and Circuits of Pneumatic and Hydraulic System, Selection of Pumps and Valves, 3/2 Way Valve, 4/2 Way Valve, 5/2 Way Valve, Electronic Controller/Automatic Controller.		
Unit III	Sensors and Transducers	8
Introduction to Sensors And Transducers, Energy form of Sensors and Transducers, Performance Terminologies, Displacement, Position and Proximity, Velocity and Motion, Fluid Pressure and Temperature Sensors, Light Sensors, Selection of Sensors, Signal Processing, Servo Systems, Digital Transducer Element, Micro Sensor, Smart Sensors.		
Unit IV	Microprocessors and Microcontroller	9
Introduction to Microprocessor, Architecture, Pin Configuration, Instruction Set, Programming of Microprocessor using 8085 Instructions, , Introduction to Microcontroller, Microcontrollers Vs Microprocessors, Architecture of 8051 Microcontrollers, Pin Configuration, Instruction Set, Interfacing D/A Converters, Interfacing A/D Converters, Applications.		
Unit V	PLC and Robotics	6
Introduction of PLC, Block Diagram of PLC, Characteristics Function of PLC, Use of PLC in Mechanical Industry. General Idea of Robot, Application of Robot in Mechanical System like Material Handling, Machine Loading and Unloading.		
Text Books	1. W Bolton ,Mechatronics, PearsonEducation 2. K. K. Appuu Kuttan , Introduction to Mechatronics, Oxford Press,London	
Reference Books	1. Mikell P. Groover , Automation, Production Systems and CIM,PHI 2. Robert H. Bishop, The Mechatronics Handbook, CRCPress 3. Annalisa Milella, Donato Di Paola and Grazia Cicirelli, Mechatronic Systems, Applications, In-Tech 3. David G. Alciatore and Michael B. Histand, Introduction to Mechatronics and Measurement Systems, Tata McGrawHill 4. Brain Morriess, Automated Manufacturing Systems – Actuators, Controls, Sensors and Robotics, McGraw Hill InternationalEdition	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for MT3603

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to understand basic fundamentals of automation in terms of mechatronics as an interdisciplinary system	2	Em
CO2	Students should be able to understand the Pneumatics and Hydraulic systems used in automating the industrial environment	2	S
CO3	Students should be able to understand the fundamentals of sensors and transducers used in automating the industrial environment	2	S
CO4	Students should be able to understand the fundamentals of Microprocessors and Microcontrollers used in automating the industrial	2	Em
CO5	Students should be able to understand the fundamentals PLC and Robotics	2	Em

CO-PO Mapping for MT3603

Course Outcomes es	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	3	3	2	1	1	1	1	1	1	1	1	1	3	2
CO 2	2	3	2	1	1	1	1	1	1	1	1	1	3	2
CO 3	2	2	1	1	1	1	1	1	1	1	1	1	2	2
CO 4	2	2	2	2	1	1	1	1	1	1	1	1	2	2
CO 5	2	3	2	1	1	1	1	1	1	1	1	1	3	2
Avg	2.2	2.6	1.8	1.2	1	1	1	1	1	1	1	1	2.6	2

MT3641	Title: Mechatronics Lab	L T P C 0 0 21
Version No.	1.0	
Course Prerequisites	NIL	
Expected Outcome	They would understand the working of devices used to develop automated systems.	

List of Experiments

1. Study of Displacement and Position Sensors
2. Study of Temperature and Pressure Sensors
3. Study of Velocity and Motion Sensors
4. Study of Microprocessor using 8085Instructions
5. Study of Timed Switch
6. Study of Windscreen Wiper Motion
7. Study of Pick and Place Robot
8. Study of Car Park Barriers
9. Study of Bar Code and Bar Reader
10. Study of Car Engine Management System

Mode of Evaluation	Internal and External Examinations
Recommendation by Board of Studies on	13-06-2019
Date of approval by the Academic Council	13-07-2019

Course Outcome for MT3641

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to get knowledge about the different types of sensors and their use in automating the machines	2	Em
CO2	Students should be able to get knowledge about the working of microprocessors in automating the machines	2	S
CO3	Students should be able to get knowledge about the working of various automated systems such as pick & place robot, windscreen wiper motion etc.	2	S

CO-PO Mapping for MT 3641

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related- 0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	2	2	1	1	2	1	1	1	1	1	1	1	3	1
CO 2	2	2	2	1	2	1	1	1	1	1	1	1	2	2
CO 3	2	3	2	2	3	1	1	1	1	1	1	1	2	2
Avg	2	2.3	1.67	1.3	2.3	1	1	1	1	1	1	1	2.33	1.67

ME3641	Title: Measurement and Metrology Lab	LTPC 0021
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To provide students with the necessary skills for measuring, calibration and testing of differentgauges and instruments.	
	List of Experiments	

1. Measurement of effective diameter of a screw thread using 3 wire methods.
2. Measurement of angle using sine bar & slip gauges.
3. Study of limit gauges and Adjustment of spark plug gap using feeler gauges.
4. Study & angular measurement using level protector and Study of dial indicator & its constructional details.
5. Use of dial indicator and V Block to check the circularity and plot the polar Graph.
6. Experiment on measurement of pressure, temperature by measuring equipment and Measurement using Strain gauge.
7. Measurement of speed using stroboscope and measurement of flow.
8. Measurement of displacement using LVDT.
9. To analyze, assess, measure and document all Measuring attributes of a selected component by using appropriate methods and devices

Mode of Evaluation	Internal and External Examinations
Recommendationby Board of Studieson	13-06-2019
Date of approval by the Academic Council	13-07-2019

Course Outcome for ME3641

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/Entrepreneurship(En)/None(*Use,formorethan One*)
CO1	Students should be able to develop the theoretical concepts taught in Mechanical Measurements & Metrology through experiments.	3	Em
CO2	Students should be able to describe the basic use of Various measuring tools measuring techniques.	3	S
CO3	Students should be able to the calibration techniques Of various measuring devices.	3	S

CO-PO Mapping for ME3641

Course Outcome s	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	2	2	1	1	2	1	1	1	1	1	1	1	3	1
CO 2	2	2	2	1	2	1	1	1	1	1	1	1	2	2
CO 3	2	3	2	2	3	1	1	1	1	1	1	1	2	2
Avg	2	2.3	1.67	1.3	2.3	1	1	1	1	1	1	1	2.33	1.67

ME3646	Title: Technical VAP	L T P C 2 0 0 2
Version No.	1.0	
Course Prerequisites	Nil	
Objective	The course aims brush-up the topics important in terms of placement activity.	
Unit No.	Unit Title	No. ofHrs (PerUnit)
Unit I	Thermal Concepts	5
Overview of Thermal concepts, Interview Questions with Solutions SET-1(50 Questions) SET-2 For Exercise, Previous Year Placement Paper Discussion and solution		
Unit II	Manufacturing Concepts	5
Overview of manufacturing concepts, Interview Questions with Solutions SET-1(50 Questions) SET-2 For Exercise, Previous Year Placement Paper Discussion and solution		
Unit III	Industrial and Quality Techniques	4
Overview and Implementation Details with Interview Questions, Previous Year Placement Paper Discussion and solution.		
Unit IV	Design Concepts	5
Overview of design concepts, Interview Questions with Solutions SET-1(50 Questions) SET-2 For Exercise, Previous Year Placement Paper Discussion andsolution		
Unit V	Software	5
Revision of Design Softwares, Revision of C & C++ and its importance in industry, Practice exercises on different software		
Text Books	1.Practice material	
Reference Books	1.Practice Material	
Mode of Evaluation	Internal and External Examinations	
Recommended by Board of Studies on	13-06-2019	
Date of Approval by the Academic Council on	13-07-2019	

Course Outcome for ME\3646

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student should be able to apply the engineering knowledge to attain the problem solving skills required during the placement drives.	3	Em
CO2	Student should be able to develop ability to face technical interviews.	3	Em
CO3	Student should be able to know the types of technical questions asked by the companies in the placement drives.	2	Em

CO-PO Mapping for ME3646

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate-2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	2	2	1	2	1	1	1	1	1	1	1	3	2	2
CO 2	2	2	1	2	1	1	1	1	2	2	1	3	3	3
CO 3	2	2	1	1	1	1	1	1	2	2	1	2	2	2
Avg	2	2	1	2.67	1	1	1	1	1.67	1.67	1	2.6	2.6	2.6

Program Electives

ME3604	Title: Gas Dynamics and Jet Propulsion	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites	ME3401	
Objectives	To understand the working of jet engines and principles of gas dynamics	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Gas Dynamics	7
Wave Motion - Compressible Fluid Flow Through Variable Area Devices ,Stagnation State Mach Number and its Influence and Properties, Isentropic Flow, Rayleigh and Fanno Flow. Deflagration and Detonation, Normal Shock and Oblique Shock Waves.		
Unit II	Aircraft Engines	7
Theory of Aircraft Propulsion, Thrust, Various Efficiencies , Different Propulsion Systems ,Turboprop, Ram Jet , Turbojet, Turbojet With After Burner, Turbo Fan and Turbo Shaft. Variable Thrust, Nozzles , Vector Control		
Unit III	Performance Characteristics of Aircraft Engines	7
Engine, Aircraft Matching, Design of Inlets and Nozzles, Performance Characteristics of Ramjet, Turbojet, Scramjet and Turbofan Engines.		
Unit IV	Rocket Propulsion	7
Theory of Rocket Propulsion , Rocket Equations , Escape and Orbital Velocity ,Multi-Staging of Rockets ,Space Missions, Performance Characteristics , Losses and Efficiencies		
Unit V	Rocket Thrust Chamber	8
Classification of propellants, Combustion in Solid and Liquid Propellant, Propellant Injection Systems, Non-Equilibrium Expansion and Supersonic Combustion, Propellant Feed Systems, Reaction Control Systems, Heat Transfer in Surface and Tip ofRocket.		
Text Books	1. S.M. Yahya, Fundamentals of Compressible Flow, New Age International Pvt Ltd.	
Reference Books	1. Philip G. Hill and Carl R. Peterson, Mechanics and Thermodynamics of Propulsion,Wesley Publishing Company, NewYork. 2. Zucrow N.J , Principles of Jet Propulsion and Gas Turbines, John Wiley and SonsNew York. 3. Zucrow N.J, Aircraft and Missile Propulsion, Vol. I and Vol. II,.John Wiley and Sons Inc, NewYork.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME 3604

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student will understand about the gas dynamics and its significance	2	Em
CO2	Student will know about Aircraft engine types and their working	2	Em
CO3	Student will understand the performance characteristics of Aircraft engines	2	Em
CO4	Student will understand about propulsion of rocket,charecteristics and about space missions	2	S
CO5	Students will know about thrust chambers and propellants	2	none

CO-PO Mapping for ME 3604

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related- 0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	2	3	2	1	1	1	1	1	1	1	1	1	3	2
CO 2	2	3	2	2	1	1	1	1	1	1	1	1	2	2
CO 3	2	2	2	2	1	1	1	1	1	1	1	1	3	2
CO 4	2	3	2	2	1	1	1	1	1	1	1	1	3	1
CO 5	2	3	2	1	1	1	1	1	1	1	1	1	2	2
Avg	2	2.8	2	1.6	1	1	1	1	1	1	1	1	2.6	1.8

ME3605	Title: Computational Fluid Dynamics	L T P C 3 0 03
Version No.	1.0	
Course Prerequisites	ME3304	
Objectives	To understand the fundamentals of CFD techniques and its application.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction	7
BasicEquationsofFluidDynamics,Incompressibleand InviscidFlow Vortex and Doublet Flow. Mathematical Properties of Fluid Dynamics Equations. Discretization of Partial Dif,ferential Equations.		
Unit II	Grid Generation	7
Structured Grids. Types and Transformations. Generation of Structured Grids. Unstructured Grids. Delany Triangulation.		
Unit III	Discretization	7
Boundary Layer Equations and Methods of Solution , Implicit Time Dependent Methods for in Viscid and Viscous Compressible Flows, Concept of Numerical Dissipation ,Stability Properties of Explicit and Implicit Methods Conservative Upwind Discretization for Hyperbolic Systems , Further Advantages of Upwind Differencing.		
Unit IV	Finite Element Techniques	7
Overview of Finite Element Techniques in Computational Fluid Dynamics. Strong and Weak Formulations of a Boundary Value Problem.		
Unit V	Finite Volume Techniques	8
Cell Centered Formulation , Runge , Kutta Time Stepping , FDM , like Finite Volume Techniques , Central and Up-wind type Discretizations , Treatment of Derivatives.		
Text Books	1. John D Ramshaw, Elements Computational Fluid Dynamics, Imperial collegepress 2. Gautam Biswas, Computational Fluid Dynamics, NarosaPublishers.	
Reference Books	1. John F Wendt, Computational Fluid Dynamics-An Introduction,Springer 2. Atul Sharma, Computational Fluid Dynamics,Wiley 3. Jens, Dominick and Muller, Essentials ofComputational Fluid Dynamics, CRC Press	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME3605

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	student will be able to understand dicretization methods used in fluid dynamics	2	Em
CO2	Student will be able to Interpret the knowledge, capability of analyzing and solving any concept or problem associated with heat energy dynamics and utilization	2	S
CO3	Student will be able to Apply the various discretization methods, solution procedures and turbulence modeling to solve flow and heat transfer problems	2	S
CO4	Student will be able to Illustrate the working concepts of thermal engineering	2	S
CO5	Student will be able to Express numerical modeling and its role in the field of fluid flow and heat transfer.	2	S

CO-PO Mapping for ME3605

Course Outcome s	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	3	3	2	2	2	1	1	1	1	1	1	2	3	2
CO 2	2	3	2	3	2	1	1	1	1	1	1	2	3	2
CO 3	3	3	2	2	2	1	1	1	1	1	1	2	3	2
CO 4	2	2	2	3	2	1	1	1	1	1	1	2	2	2
CO 5	3	3	2	3	3	1	1	1	1	1	1	2	3	2
Avg	2.6	2.8	2	2.6	2.2	1	1	1	1	1	1	2	2.8	2

ME3606	Title: Production Planning and Control	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	The main objective of this subject is to understand the various tools of planning and control used for the optimal utilisation of various resources used in industry.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction	7
Objectives and Benefits of Planning and Control, Functions of Production Control, Types of Production (Job, Batch and Continuous),ProductDevelopmentandDesign,MarketingAspect,FunctionalAspects,OperationalAspect,Durabilityand Dependability Aspect, Aesthetic Aspect. Profit Consideration, Standardization, Simplification and Specialization, Break Even Analysis, Economics of a New Design		
Unit II	Production Planning	7
Product Planning, Extending the Original Product Information, Value Analysis, Problems in Lack of Product Planning, Process Planning and Routing, Pre Requisite Information Needed for Process Planning, Steps in Process Planning, Quantity Determination in Batch Production, Machine Capacity, Balancing, Analysis of Process Capabilities in a Multi-Product System		
Unit III	Production Control	9
Production Control Systems, Loading and Scheduling, Master Scheduling, Scheduling Rules, Gantt Charts, Perpetual Loading, Basic Scheduling Problems, Line of Balance, Flow Production Scheduling, Batch Production Scheduling, Product Sequencing, Production Control Systems, Periodic Batch Control, Dispatching, Progress Reporting and Expediting, Manufacturing Lead Time, Techniques for Aligning Completion Times and Due Dates.		
Unit IV	Inventory Control	8
Inventory Control, Purpose of Holding Stock, Effect of Demand on Inventories, Ordering Procedures. Two Bin System, Ordering Cycle System, Determination of Economic Order Quantity and Economic Lot Size, ABC Analysis		
Unit V	Quality Control and Production Systems	5
Quality Control Tools (Check Lists, Histogram, Pareto Charts, Fishbone Diagram, Control Chart Flow Charts and Scatter Plots), Fundamentals of MRP and ERP, 5S, 6S, Kaizen, Poka Yoke, Kanban, JIT, Introduction to Computer Integrated Production Planning Systems.		
Text Books	1. Martand Telsang,IndustrialEngineeringandProductionManagement,S.ChandandCompany. 2. James.B.Dilworth, Operations management – Design, Planning and Control formanufacturing and services, McGraw Hill International.	
Reference Books	1. Melynk, Denzler, Irwin , Operations Management – A value driven approach McGrawHill. 2. Jain. K.C and L.N. Aggarwal, Production Planning Control and Industrial Management, KhannaPublishers. 3. Chary. S.N , Theory and Problems in Production and Operations Management, Tata McGraw Hill 4. S.K.Mukhopadyay, Production planning and control-Text and cases,PHI	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME3606

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student will be able to understand the importance and benefits of production planning and control along with their various aspects.	2	Em
CO2	Ability to do the planning for production processes	2	S
CO3	Ability to do the production control of production processes	2	S
CO4	Control the inventory in the plant so that right amount of inventory in right time is available for smooth production operation.	2	S
CO5	Ability to do the control of quality and know about the production systems.	2	S

CO-PO Mapping for ME 3606

Course Outcome s	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	2	3	2	1	1	1	1	1	1	1	1	2	3	3
CO 2	2	3	2	1	1	1	1	1	1	1	2	2	3	2
CO 3	2	2	2	2	1	1	1	1	2	1	2	1	2	2
CO 4	2	3	2	1	2	1	1	1	1	1	1	2	2	3
CO 5	2	3	1	1	1	1	1	1	2	1	2	2	3	2
Avg	2	2.8	1.8	1.2	1.2	1	1	1	1.4	1	1.6	1.8	2.6	2.4

ME3607	Title: Plant Layout and Material Handling	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites	--	
Objectives	Student will be able know about plant location, plant layout and materials handling.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Plant Location and Facilities	7
Factors to be Considered for Plant Location and Plant Layout, Consideration in Facilities Planning, Equipments Required for Plant Operation, Selection of Equipments Considering Plant Capacity, Serviceability, Flexibility, Space and Man Power Requirements.		
Unit II	Plant Layout	7
Need for Layout, Types of Layout, Factors Influencing Plant Layout(Product, Process, Fixed and Combination Layout), Tools and Techniques for Developing Layout, Process Chart, Flow Diagram, String Diagram, Template and Scale Models, Machine Specifications. Layout Planning Procedure. Visualization of Layout, Revision and Improving Existing Layout, Balancing of Fabrication and Assembly Lines.		
Unit III	Material Handling	7
Importance, Scope and Principles of Material Handling. Planning, Operating and Costing Principles, Factors Influencing the Selection of Material Handling Systems, Types of Material Handling Systems.		
Unit IV	Analysis of Material Handling	7
Motion Analysis, Flow Analysis, Graphic Analysis, Safety Analysis, Equipment Cost Analysis, Palletization Analysis, Analysis of Operation, Material Handling Surveys.		
Unit V	Industrial Building and Utilities	8
Centralized Electrical, Pneumatic, Water Line Systems, Types of Buildings, Lighting, Heating, Air Conditioning and Ventilation Utilities, Planning and Maintenance, Industrial Waste Handling. Packing and Storage Materials. Importance of Packaging, Layout for Packaging, Packaging Machinery, Wrapping and Packing Materials, Cushion Materials.		
Text Books	1. B. K. Aggarwal, Plant Layout and Material Handling, JainBrothers. 2. S. C. Sharma, Plant Layout and Material Handling, KhannaPublishers.	
Reference Books	1. James M. Apple, Plant Layout and Material Handling, John Wiley andSons. 2. Fred E. Meyers, Plant Layout and Material Handling, PrenticeHall.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME3607

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student will be able to understand Plant Location and Facilities	2	Em
CO2	Student will be able to know Plant Layout	2	S
CO3	Student will be able to get knowledge about Material Handling	2	S
CO4	Student will be able to understand about Analysis of Material Handling	2	S
CO5	Student will be able to Industrial Building and Utilities	2	S

CO-PO Mapping for ME3607

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	2	3	2	1	1	1	1	1	1	1	1	2	3	3
CO 2	2	3	2	1	1	1	1	1	1	1	2	2	3	2
CO 3	3	2	2	2	1	1	1	1	2	1	2	1	2	2
CO 4	3	2	2	1	2	1	1	1	1	1	1	2	2	3
CO 5	2	3	1	1	1	1	1	1	2	1	2	2	3	2
Avg	2.4	2.6	1.8	1.2	1.2	1	1	1	1.4	1	1.6	1.8	2.6	2.4

ME3608	**Title: Advanced Engineering Materials**	**L T P C** **3 0 03**
Version No.	**1.0**	
Course Prerequisites	Nil	
Objectives	Students be made aware of advances in material for selecting appropriate advanced engineering materials for different engineering applications.	
Unit No.	**Unit Title**	**No. of hours(per Unit)**
Unit I	**Ferrous Materials**	6
Introduction, Fe-C Phase Diagram, Steel, Low Carbon Steel, Dual Phase Steels, Micro Alloying Steels, Weathering Steels, Free Cutting Steels, Medium Carbon Steels, High Strength Structure Steels, Ausformed Steels, Martensitie Stainless Steels, Tool Materials – Classification, Properties, Heat Treatment of High Speed Steel, Tool for Cold and Hot Forming, Tools for High Speed Cutting, Cast Iron, Grey Cast Iron, White Cast Iron, Malleable Cast Iron, Properties and Applications.		
Unit II	**Non Ferrous Materials**	9
Introduction, Types of Non Ferrous Materials, Cu and Cu Alloys, Properties and Applications, Aluminum, Cast Aluminum Alloys, Wrought Aluminum Alloys, Properties and Applications, Ti and its Alloys, Properties and Applications Mg and its Alloys, Properties and Applications, Super Alloys : Ni, Fe and Co Based Alloys, Properties and Applications, Bio- Materials,Bio Compatibility, Applications and Properties.		
Unit III	**Polymeric and Ceramic Materials**	7
Introduction to Thermoplastic and Thermosettting Plastics, Industrial Polymerization Method, Processing of Plastic Materials, Processes used for Thermoplastic Materials: Injection Moulding, Extrusion, Blow Moulding and Thermo Forming, Charecteristics and Applications, Processes used for Thermosettting Materials: Compression Moulding, Transfer Moulding and Injection Moulding, Ceramic Materials: Processing of Ceramics, Forming – Pressing, Dry Pressing, Isostatic Pressing, Hot Pressing, Slip Casting , Extrusion, Thermal Treatment, Vitrification, Properties and Applications, Engineering Ceramics – Alumina,Silicon Carbide.		
Unit IV	**Composite Materials and Conducting Materials**	7
Composite Materials : Classification, MMC's Preparation of Composite Materials, Properties and Applications, FRP Composites,Processing of Composite Materials, Properties and Applications, Semi Conducting Materials, Intrinsic and Extrinsic Semi Conduction, Semi Conductor Devices, Properties and Applications, Super Conducting Materials, Super Conducting Oxide.		
Unit V	**Magnetic and Smart Materials**	7
Hard Magnetic Materials, Properties and Applications, Smart Materials: Classification, Piezo Electric Materials, RheologicalMaterials, Smart Gels, Chromic Materials, Thermo Responsive Materials Magneto-Strictive Materials, Electro- Stricitve Materials, Nanotechnology Materials Synthesis, Properties, Carbon Nanotechnology Tubes and Applications.		
Text Books	1. Van Vlack, Elements of Material Science and Engineering, Pearson EducationIndia. 2. K.M.Gupta, Engineering Materials-Research, Applications and Advances, CRCPress.	
Reference Books	1. V.D. Kodgire , Material science and Metallurgy, Everest PublishingHouse. 2. D.R.AskelandandP.P.Phule,TheScienceandEngineeringofMaterials,, ThomsonPublication. 3.AshutoshTiwariandArulMurugan,AdvancedEngineeringMaterialsandModelling, Wiley.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Boardof Studies on	13-06-2019	
Date of approval by theAcademic Council	13-07-2019	

Course Outcome for ME3608

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to understand the Ferrous Materials	2	Em
CO2	Students should be able to understand the Non-Ferrous Materials	2	S
CO3	Students should be able to understand the Polymeric and Ceramic Materials	2	S
CO4	Students should be able to understand the Composite Materials and Conducting Materials	2	S
CO5	Students should be able to understand the Magnetic and Smart Materials	2	S

CO-PO Mapping for ME 3608

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	3	3	2	2	1	1	1	1	1	1	1	1	3	2
CO 2	3	3	1	2	1	1	1	1	1	1	1	1	3	2
CO 3	2	2	1	1	1	1	1	1	1	1	1	1	3	2
CO 4	3	2	2	2	2	1	1	1	1	1	1	1	3	2
CO 5	3	2	2	2	2	1	1	1	1	1	1	1	2	2
Avg	2.8	2.4	1.6	1.8	1.2	1	1	1	1	1	1	1	2.8	2

ME3609	Title: Welding Technology	L T P C 3 0 03
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To understand the fundamentals of various welding processes and to learn about their mechanisms, advantages, limitations and application areas.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Gas and Arc Welding Processes	8
Fundamental Principles – Air Acetylene Welding, Oxyacetylene Welding, Carbon Arc Welding, Shielded Metal Arc Welding, Submerged Arc Welding, TIG and MIG Welding, Plasma Arc Welding and Electroslag Welding Processes – Advantages, Limitations and Applications. Heat Affected Zone (HAZ).		
Unit II	Resistance Welding Processes	7
Spot Welding, Seam Welding, Projection Welding, Resistance Butt Welding, Flash Butt Welding, Percussion Welding and High Frequency Resistance Welding Processes – Advantages, Limitations and Applications.		
Unit III	Solid State Welding Processes	7
Cold Welding, Diffusion Bonding, Explosive Welding, Ultrasonic Welding, Friction Welding, Forge Welding, Roll Welding and Hot Pressure Welding Processes – Advantages, Limitations and Applications.		
Unit IV	Other Welding Processes	7
Thermit Welding, Atomic Hydrogen Welding, Electron Beam Welding, Laser Beam Welding, Friction Stir Welding, Under Water Welding, Welding Automation in Aerospace, Nuclear and Surface Transport Vehicles.		
Unit V	Weld Joints, Weldability and Testing of Weldments	7
Various Weld Joint Designs, Weldability of Aluminium, Copper, and Stainless Steels. Destructive and Non-Destructive Testing of Weldments.		
Text Books	1. Parmer R.S., Welding Engineering and Technology, Khanna Publishers, NewDelhi. 2. Little R.L., Welding and welding Technology, Tata McGraw Hill Publishing Co., Ltd., NewDelhi.	
Reference Books	1. Schwartz M.M , Metals Joining Manual, McGraw HillBooks. 2. Tylecote R.F., The Solid Phase Welding of Metals, Edward Arnold Publishers Ltd. London. 3. AWS- Welding Hand Book.. Vol- 2. WeldingProcess 4. Nadkarni S.V. , Modern Arc Welding Technology, Oxford IBHPublishers. 5. Davis A.C , The Science and Practice of Welding, Cambridge UniversityPress.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME 3609

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to understand the Gas and Arc Welding Processes	2	Em
CO2	Students should be able to understand the Resistance Welding Processes	2	S
CO3	Students should be able to understand the Solid State Welding Processes	2	S
CO4	Students should be able to understand the Other Welding Processes	2	Em
CO5	Students should be able to understand the Weld Joints, Weldability and Testing of Weldments	2	S

CO-PO Mapping for ME 3609

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	3	3	2	1	1	1	1	1	1	1	1	2	3	2
CO 2	3	3	2	1	1	1	1	1	1	1	1	1	3	2
CO 3	3	3	2	1	1	1	1	1	2	1	1	2	2	2
CO 4	3	2	2	1	1	1	1	1	1	1	1	1	2	2
CO 5	3	3	2	1	1	1	1	1	1	1	1	2	3	2
Avg	3	2.8	2	1	1	1	1	1	1.2	1	1	1.6	2.6	2

SEMESTER 7

ME 3701	Title: CAD/CAM	L T P C 3 2 04
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To provide knowledge on different CAD modeling and CAM techniques.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction and Wire Frame Modelling	6
Introduction to CAD/CAM, product cycle, CAD/CAM system evaluation criteria, input and output devices, graphic standards and exchange formats (IGES, STEP, STL). Transformations (both 2D and 3D) Introduction of FEM, wire frame modeling: wire frame entities and their definition, properties of curves, parametric representation of synthetic curves Hermite cubic spline, Bezier curves, B-spline curves.		
Unit II	Surface and Solid Modeling	8
Surface modeling: surface representation analytic surfaces: definition of plane surface, ruled surface, surface of revolution, tabulated cylinder, synthetic surfaces- hermit bicubic surface, Bezier surface, b- spline surface, coons' surface, blending surface, sculptured surface. Solid modeling: solid models and representation scheme B-REP & CSG, sweep representation, cell decomposition, spatial occupancy enumeration		
Unit III	Numerical Control of Machine Tools	8
Features and elements of NC, types of NC systems: PTP, straight cut and contouring, MCU & other components, co-ordinate system, NC manual part programming, formats for writing part program, G & M codes, and part program for drilling and milling of simple parts. Apt programming CNC: introduction to CNC, typical configurations, machining centers, introduction to FANUC, SIEMENSControllers DNC: typical configurations, comparison between CNC vs DNC vs NC vs ordinary machinetools		
Unit IV	System Devices and Control of NC Systems	6
Introduction to DC motors, stepping motors, feedback devices such as encoder, counting devices, digital to analog converter and vice versa.Open and closed loops. Automatic control of closed loops with encoder & tachometers. Speed variation of DC motor. Adaptive control systems: ACO and ACC		
Unit V	Advance ments	8
GT: part families, layout, part classification and coding system- OPITZ, MICLASS. CAPP: variant and generative process planning. FMS and CIM: FMS equipment, FMS layouts, benefits of FMS, elements of CIM. Computer aided inspection and QC: automated inspection- off-line, on-line, contact (co-ordinate measuring machine), non- contact inspection (machine vision, scanning laser beam, photogrammetry)		
Text Books	1. A Zimmers and P. Groover, CAD/CAM,PHI 2. Ibrahim Zeid CAD/CAM Theory and Practice,TMH 3. P.N. Rao, CAD/CAM,TMH	
Reference Books	1. Vikram Sharma, Fundamental of CAD/CAM, Ketsonbooks 2. Sareen & Grewal, CAD/CAM theory and Concepts,S.Chand 3. Yoram Koren, Computer Control of Manufacturing Systems, McGrawHill	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome For ME 3701

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to develop an understanding of the basics of CAD/CAM, exchange formats, transformation techniques, Basic of FEM and wireframe modeling.	2	Em
CO2	Students should be able to attain a theoretical understanding of surface modeling and solid modeling.	4	S
CO3	Students should be able to understand about NC machine, Part programming by using G and M Code, CNC and DNC machine.	3	S
CO4	Students should be able to attain a theoretical understanding of System devices and method to control NC system.	2	S
CO5	Students should be able to theoretically analyze about advance tool which is used in CAM systems.	2	S

CO-PO Mapping for ME 3701

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	2	2	3	2	3	1	1	1	1	1	1	2	2	2
CO 2	3	3	2	3	3	1	1	1	1	1	1	2	2	2
CO 3	3	2	3	2	3	2	1	1	2	1	1	2	3	3
CO 4	3	2	2	2	3	1	1	1	1	1	1	2	2	2
CO 5	2	2	3	3	3	2	1	1	2	1	1	3	2	3
Avg	2.6	2.2	2.6	2.4	3	1.4	1	1	1.4	1	1	2.2	2.2	2.4

ME3715	Title: Industrial Engineering and Management	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To provide knowledge on different concepts regarding organization and productivity in industries and to know methods to plan and control production systems for effective management.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction and Concepts of Management	10
Definition and scope of industrial engineering, functions of industrial engineering department and its organization, qualities of an industrial engineer, concept of production and productivity. Functions of management, evolution of management thought: Taylor's scientific management, Fayol's principles of management, Douglas Mc-Gregor's theory x and theory y, mayo's Hawthorne experiments, Hertzberg's two factor theory of motivation, Maslow's hierarchy of human needs – systems approach to management.		
Unit II	Designing Organizational Structures and Management Planning	8
Concept, importance and characteristics of organization, types of organization - project, matrix and informal organization. Span of control, delegation of authority. Steps, hierarchy, principles and dimensions of planning function, approaches to decision making, decision support systems, basic control process, control parameters, principles of control.		
Unit III	Plant Location and Layout	8
Plant location: definition, factors affecting the plant location, comparison of rural and urban sites-methods for selection. Plant layout: needs for a good layout, different types viz. product, process and combination layouts, introduction to layouts based on the gt, jit and cellular manufacturing systems, development of plant layout.		
Unit IV	Work Analysis	9
Definition, need and scope of work analysis. Method-study: definition, objectives, step-by-step procedure, questioning techniques, charts and diagrams for recording data. Principles of motion economy; development and installation of new method. Work–measurement: definition, various techniques of work-measurement such as work-sampling, stopwatch time study & its procedure, job selection, equipment and forms used for work measurement, need for rating operator, methods of rating, allowances and their types, standard time. Standard data techniques.		
Unit V	Productivity and Value Engineering	5
Definition, reasons for low productivity, methods to improve productivity, relation between work-study and productivity. Value engineering- definition, types of values, concept, phases and application of value engineering		
Text Books	1. Industrial Engineering & Management,Philip E Hick, Tata McGraw Hill 2.Techniques of Value Analysis and Engineering, Lawrence D. Miles McGraw Hill.	
Reference Books	1. Management of Systems, Rajnish Parkash, R.N. Nauhria,Wheeler Publishers 2. Modern Production Management,S. Buffa, Wiley Eastern 3. Work Study and Ergonomics,H.S. Shan, Dhanpat Rai and Co. (P) Ltd.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME 3715

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student should be able to understand the management principles.	2	Em
CO2	Student should be able to know the organizational structure and approaches for decision making process.	3	S
CO3	Student should be able to understand the layout of a manufacturing plan	3	S
CO4	Student should be able to apply the method study and perform work measurement techniques for productivity.	2	S
CO5	Student should be able to understand methods to improve productivity and importance of value engineering.	2	S

CO-PO Mapping for ME 3715

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	3	2	1	1	1	1	1	1	1	1	1	1	3	2
CO 2	3	2	2	2	1	1	1	1	2	2	1	1	3	2
CO 3	2	2	1	1	1	1	1	1	1	1	1	1	2	2
CO 4	3	2	1	2	1	1	1	1	1	1	1	1	3	2
CO 5	3	2	2	1	1	1	1	1	1	1	1	1	3	2
Avg	2.8	2	1.4	1.4	1	1	1	1	1.2	1.2	1	1	2.8	2

ME3740	Title: CAD/CAM Lab	L T P C 0 0 21
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To study design and manufacturing techniques using computer.	
	List of Experiments	

1. To study about CAD package and working in sketch mode and understand part features and draw Part modeling of various machine components
2. To draw the components of screw jack and to assemble them using CAD software.
3. To draw the components of crosshead and to assemble them using CAD software.
4. To draw the components of universal coupling and to assemble them using CAD software
5. To draw the components of Plummer Block and to assemble them using CAD software.
6. To draw a machine component and indicate tolerances on size and geometrical form, position; indicate surface finish, surface treatments and write process sheet for anyone component.
7. To Study CNC Lathe Machine (MTab FANUC controller – standard feature & machine specification)
8. To write a part program and simulate the tool part for the given model using FANUC controller for facing.
9. To write a part program and simulate the tool part for the given model using FANUC controller for step turning and taper turning.
10. To write a part program and simulate the tool part for the given model using FANUC controller for thread cutting.
11. To design a product and manufacture/generate CNC machining tool path for its components.

Mode of Evaluation	Internal and External Examinations
Recommendation by Board of Studies on	13-06-2019
Date of approval by the Academic Council	13-07-2019

Course Outcome for ME 3740

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to develop an understanding about CAD package and working in sketch mode and understand part features and draw Part modeling of various machine components.	4	Em
CO2	Students should be able to know about CNC Lathe Machine (MTab FANUC controller – standard feature & machine specification)	2	S
CO3	Students should be able to write a part program and simulate the tool part for the given model using FANUC controller for facing, step turning, taper turningand thread cutting.	4	S

CO-PO Mapping for ME 3740

Course Outcom es	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	3	2	2	2	3	1	1	1	1	1	1	2	2	1
CO 2	2	2	2	3	3	1	1	1	1	1	1	2	1	1
CO 3	3	3	2	2	3	2	1	1	2	1	1	2	2	3
Avg	2.6	2.3	2	2.3	3	1	1	1	1	1	1	2	1.6	1.6

ME3743	Title: Industrial Engineering and Quality control Lab	L T P C 0 0 2 1
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To provide students with the necessary skills for measuring, calibration and testing of different gauges and instruments.	
	List of Experiments	

1. Apply method study approach to analyze the motions involved in machining operation of the given job
2. Apply work measurement technique to analyze the time components involved machining operation of given job using stop watch.
3. Calculate standard time for all the operations involved in step turning process.
4. Prepare detailed process plan for manufacturing of Hexagonal Nut/Hexagonal headed bolt/Stud/Wing Nut/Plain Washer.
5. Prepare and analyse steps to solve the given problem in institute/industry using quality circle concept.
6. Redesign the given simple lever(s) like gear shifting lever/brake/clutch lever/foot lever for best ergonomic aspect.
7. Draw and interpret the control charts (P-chart and C-chart) for given data
8. Case study on X bar charts and process capability analysis
9. Draw P Chart: (a)Verify the Binomial Distribution of the number of defective balls by treating the balls with a red colour to be defective. (b) Plot a P-chart by taking a sample of n=20 and establish control limits.

Mode of Evaluation	Internal and External Examinations
Recommendation by Board of Studies on	13-06-2019
Date of approval by the Academic Council	13-07-2019

Course Outcome for ME 3743

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student will be able to understand and apply work measurement technique to analyse time component for a given job	3	Em
CO2	Student will be able to prepare process plan and analyse steps using quality circle concept	3	S
CO3	Student will be able to draw P chart,C chart and X bar chart for the given cases	3	S

CO-PO Mapping for ME 3743

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	3	2	2	2	2	1	0	0	1	1	1	2	0	1
CO 2	2	2	2	2	2	1	0	0	1	1	1	2	1	1
CO 3	3	2	2	2	1	2	0	0	2	1	1	2	2	3
Avg	2.6	2	2	2	1.6	1	0	0	1	1	1	2	1	1.6

ME3746	Title: Technical VAP II	L T P C 2 0 0 2
Version No.	1.0	
Course Prerequisites	Nil	
Objective	The course aims brush-up the topics important in terms of placement activity.	
Unit No.	Unit Title	No. of Hrs (Per Unit)
Unit I	Thermal Concepts	5
Overview of thermal concepts, interview questions with solutions set 1(50 questions) set 2 for exercise, previous year placement paper discussion and solution		
Unit II	Manufacturing Concepts	5
Overview of manufacturing concepts, interview questions with solutions set 1(50 questions) set 2 for exercise, previous year placement paper discussion and solution		
Unit III	Industrial and Quality Techniques	4
Overview and implementation details with interview questions, previous year placement paper, discussion and solution.		
Unit IV	Design Concepts	5
Overview of design concepts, interview questions with solutions set 1(50 questions) set 2 for exercise, previous year placement paper discussion and solution		
Unit V	Aptitude and Logical Reasoning	5
Revision of quantitative aptitude tips, Review of reasoning tips, Discussion of old question papers, practice tests on major placement question papers on reasoning and quantitative aptitude.		
Text Books	1. Practice Material	
Reference Books	1. Practice Material	
Mode of Evaluation	Internal and External Examinations	
Recommended by Board of Studies on	13-06-2019	
Date of Approval by the Academic Council on	13-07-2019	

Outcome for ME 3746

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student should be able to apply the engineering knowledge to attain the problem-solving skills required during the placement drives.	3	Em
CO2	Student should be able to develop ability to face technical interviews.	3	S
CO3	Student should be able to know the types of technical questions asked by the companies in the placement drives.	2	S

CO-PO Mapping for ME 3746

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	3	3	1	2	2	1	1	1	1	1	1	3	2	2
CO 2	3	3	3	3	3	1	1	1	1	1	1	3	3	3
CO 3	1	1	1	1	1	1	1	1	2	1	1	2	1	1
Avg	2.3	2.3	1.6	2	2	1	1	1	1.3	1	1	2.6	1.6	1.6

Program Electives

ME3703	**Title: Alternative Fuels and Energy Systems**	**L T P C** **3 0 0 3**
Version No.	**1.0**	
Course Prerequisites	Nil	
Objectives	To introduce students to bio-fuels, hydrogen energy and solar energy and to expose students to future energy systems.	
Unit No.	**Unit Title**	**No. of hours (per Unit)**
Unit I	**Introduction**	7
Introduction: estimation of petroleum reserve , need for alternate fuels, availability and properties of alternate fuels, astm standards, merits and demerits of various alternate fuels.		
Unit II	**Alcohols and Vegetable Oils**	7
General use of alcohols, properties as engine fuel, alcohols and gasoline blends, performance in si engine, methanol and gasoline blends, combustion characteristics in engines, emission characteristics. Soyabeen oil, jatropha, pongamia, rice bran, mahuaetc as alternate fuel for engines, etherification, esterification, performance in engines.		
Unit III	**Natural Gas, LPG, Hydrogen and Biogas**	8
Availability of CNG, properties, modification required to use in engines, performance and emission characteristics of CNG using LPG in SI and CI engines, performance and emission of LPG. Hydrogen; Hydrogen production, hydrogen as an alternative fuel, fuel cell, performance and safety aspects. Biogas production, performance and emission characteristics.		
Unit IV	**Electric and Solar Powered**	7
Layout of an electric vehicle, advantage and limitations, specifications ,systemcomponent, electronic control system, high energy and power density batteries, hybrid vehicle, solar powered vehicle.		
Unit V	**Emission and Control**	7
Need for emission control, classification/ categories of emissions, major pollutants, control of emissions, evaluating vehicle emissions, Euro I,II,III,IV standards, Indian standards		
Text Books	1. Dr. S. Thipse, Alternate Fuels, Jaico Publications. 2. Ayhan Demirbas, Biodiesel A Realistic Fuel Alternative for Diesel Engines, Springer- Verlag London Limited	
Reference Books	1. Richard.L.Bechfold,Alternative Fuels Guide Book, SAE International 2. Halderman, J. D., & Linder, J, Automotive fuel and emissions control systems, Pearson Higher Ed	
Mode of Evaluation	Internal and external examination	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME3703

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to understand the need of alternative fuels.	2	Em
CO2	Students should be able to compare different types of alcohols and vegetable oils.	2	S
CO3	Students will aware about the production of natural gas, LPG, Hydrogen and Biogas.	2	S
CO4	Students should be able to understand the need of electric and solar power.	2	S
CO5	Students should be able to understand different emission control techniques.	2	S

CO-PO Mapping for M 3703

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	2	2	3	2	1	1	2	2	1	1	1	2	2	2
CO 2	3	3	2	3	2	1	3	1	1	1	1	2	2	2
CO 3	3	2	2	2	2	2	2	1	1	1	1	2	3	3
CO 4	3	2	2	2	2	3	2	1	1	1	1	2	2	2
CO 5	2	2	3	3	1	2	3	1	1	1	1	3	2	3
Avg	2.6	2.2	2.4	2.4	1.6	2.8	2.4	1.2	1	1	1	2.2	2.2	2.4

ME3704	Title: Fuels and Combustion	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To know the available fuels and their characteristics along with combustion behavior.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Basics	7
Fuels types and characteristics of fuels, determination of properties of fuels, fuels analysis - proximate and ultimate analysis, moisture determination, calorific value -gross and net calorific values, calorimetry, Dulong's formula for cv estimation, flue gas analysis, Orsat apparatus, fuel and ash storage and handling, spontaneous ignition temperatures.		
Unit II	Solid and Liquid Fuels	7
Solid fuels: wood and wood charcoal, origin of coal, composition of coal, analysis and properties of different grades of coal, preparation and storage of coal-coal washing, briquetting. Liquid coals: origin of petroleum fuels-production, composition, petroleum refining, various grades of petro-products properties and testing, alcohol shale oil gasification of liquid fuels, synthetic fuels, storage and handling of liquid fuels.		
Unit III	Gaseous Fuels	7
Classification, composition and properties, estimation of calorific value, gas calorimeter. Rich and lean gas - Wobbe index, natural gas, dry and wet natural gas, stripped ng, foul and sweet NG, LPG, LNG, CNG, methane, producer gas –gasifiers, water gas, town gas, coal gasification, gasification efficiency, non-thermal route, biogas, digesters – reactions, viability, economics.		
Unit IV	Combustion	8
Stoichiometry - mass basis and volume basis, excess air calculation - fuel and flue gas compositions – calculations, rapid methods, combustion processes, stationary flame, surface or flameless combustion, submerged combustion, pulsating and slow combustion explosive combustion. Mechanism of combustion – ignition and ignition energy - spontaneous combustion -flame propagation - solid - liquid and gaseous fuels combustion, flame temperature, theoretical, adiabatic and actual - ignition limits – limits of inflammability.		
Unit V	Air Pollution	7
Types of pollution - combustion-generated air pollution - effects of air pollution -pollution of fossil fuels and its control - pollution from automobiles and its control.		
Text Books	1. Samir Sarkar ,Fuels and combustion, Orient Black Swan Publication	
Reference Books	1. SharmaS.P., Cahandramohan,Fuels and combustion, Tata McGraw-Hill. 2. William H Booth,Liquid Fuel and Its Combustion, Forgotten Books	
Mode of Evaluation	Internal and external examination	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME3704

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should aware about different types of fuel and can estimate their properties.	2	Em
CO2	Students should be able to compare different solid and liquid fuels	2	S
CO3	Students will aware about the production and thermo-physical properties of gaseous fuel.	2	S
CO4	Students should be able to understand the mechanism of combustion.	2	S
CO5	Students should aware about air pollution caused by different fuel combustion	2	S

CO-PO Mapping for ME3704

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	2	3	2	2	1	2	1	1	1	1	1	2	2	2
CO 2	2	2	2	2	2	2	1	1	1	1	1	1	2	1
CO 3	3	2	3	2	1	2	1	1	2	1	1	2	3	2
CO 4	3	2	2	2	1	1	1	1	1	1	1	2	2	2
CO 5	2	2	2	3	1	2	1	1	2	1	1	1	2	2
Avg	2.4	2.2	2.2	2.2	1.2	1.8	1	1	1.4	1	1	1.6	2.2	1.8

ME3705	Title: Reliability Engineering	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To impart the knowledge on principles of reliability, failure rate and its relation to reliability.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction	8
Reliability: definition; probability concept; addition of probabilities; complimentary events; Kolmogorov axioms. Failure data analysis: introduction, mean failure rate, mean time to failure (MTTF), mean time between failures (MTBF), graphical plots, MTTF in terms of failure density, MTTF in integral form.		
Unit II	Hazards Models and Conditional Probability	9
Hazard models: introduction, constant hazard; linearly increasing hazard, the Weibull model, density function and distribution function, reliability analysis, important distributions and their choice, standard deviation and variance. Conditional probability: introduction, multiplication rule, independent events, Venn diagram, hazard rate as conditional probability, Bayes theorem.		
Unit III	Reliability Improvement	8
System reliability: series. Parallel and mixed configurations, complex systems, logic diagrams, Markova models. Reliability improvement & repairable systems: redundancy, element, unit and standby redundancy, optimization; reliability – cost trade-off		
Unit IV	Fault Tree Analysis	7
Fault-tree analysis and other techniques: fault-tree construction, calculation of reliability, tie- set and minimal tie-set. Introduction to repairable systems, instantaneous repair rate, MTTR, reliability and availability functions, important applications,8D method,5 rule sheet.		
Unit V	Maintainabilty and Avalability	8
Maintainability and availability: introduction, maintenance planning, reliability and maintainability trade – off. Up time, down time, total time, system breakdown maintenance. Various types of maintenance plans		
Text Books	1. L.S. Srinath,,Reliability Engineering, Affiliated East-West Press, New Delhi. 2. A.K.Govil, Reliability Engineering, Tata Mc-Graw Hill, New Delhi.	
Reference Books	1. L.Balagurusamy ,Reliability Engineering, Tata Mc-Graw Hill, New Delhi. 2. S. Rao, Reliability Based Design, Mc-Graw Hill, 3. K.C. Kapur and L.R. Lamberson, Reliability in Engineering Design,Wiley Publications. 4. D.J. Smith,Reliability Engineering, , E.W. Publications.	
Mode of Evaluation	Internal and external examination	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME3705

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to understand the concepts of reliability and carry out reliability data analysis.	2	Em
CO2	Students should be able to understand the concept of hazards models and conditional probability.	2	S
CO3	Student should be able to get acquainted with computation of system reliability and reliability improvement methods.	2	S
CO4	Student should be able to understand the concepts of fault tree analysis and techniques related to it.	2	S
CO5	Student should be able to understand the maintainability and availability and relate it with failure rate	2	S

CO-PO Mapping for ME 3705

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	2	2	3	2	3	1	1	1	1	1	1	2	2	2
CO 2	2	1	2	3	2	1	1	1	1	1	1	2	2	2
CO 3	2	2	3	3	2	1	1	1	1	1	1	1	1	1
CO 4	3	3	2	2	3	1	1	1	1	1	1	2	2	2
CO 5	2	2	3	3	3	1	1	1	1	1	1	1	2	1
Avg	2.2	2	2.6	2.6	2.6	1	1	1	1	1	1	1.6	1.8	1.6

ME3706	Title: Statistical Quality Control	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To understand statistical description of quality, control charts for variables and attributes, process capability analysis and techniques.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction	10
Concept of quality, quality characteristics, quality standards, quality cost, concept of quality control, quality control methodology, statistical methods of quality control, Statistical Description of Quality: Population and sample, techniques of sampling, simple random sample, analysis of sample data, representation of sample data, practical examples.		
Unit II	Control Charts	10
Basis of control chart, types of control chart, design of control chart, analysis of control chart, control charts for variables and attributes, case studies.		
Unit III	Process Capability	8
Concept of process capability, measures of process capability, potential process capability, actual process capability, process capability analysis, case studies.		
Unit IV	Acceptance Sampling	6
Basis of sampling schemes, types of sampling schemes, acceptance sampling schemes for variables and attributes, operating characteristic curve, producer's risk, consumer's risk, rectifying inspection.		
Unit V	Six Sigma	6
Concept of six sigma, methods of six sigma, DMAIC methodology, DFSS methodology, six sigma control chart, case studies.		
Text Books	1. M. Mahajan, Statistical Quality Control,Dhanpat Rai and Co. 2. D.C. Montgomery,Introduction to statistical quality control, John Wiley & Sons.	
Reference Books	1. Eugene Grant, Richard Leavenworth, Statistical Quality Control, Mc Graw hill 2. K. Krishnaiah Applied Statistical Quality Control and Improvement,PHI	
Mode of Evaluation	Internal and external examination	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME 3706

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student should be able to understand the concepts of quality, quality assurance and management.	2	Em
CO2	Student should be able to demonstrate the ability to use the methods of statistical process control and able to use and interpret control charts for variables.	3	S
CO3	Student should be able to use appropriate statistical concepts, processes, tools, and technologies in the solution to various conceptual and real-world problems.	3	S
CO4	Students should be able to understand sampling and its related terminology.	3	S
CO5	Student should be able to understand the concept of six sigma and its case studies.	2	S

CO-PO Mapping for ME 3706

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	2	2	3	2	3	1	1	1	1	1	2	2	2	2
CO 2	2	3	2	3	2	1	1	1	1	1	2	1	2	2
CO 3	2	2	3	2	3	1	1	1	1	1	2	2	3	3
CO 4	2	2	2	2	3	1	1	1	1	1	1	2	2	2
CO 5	2	2	3	3	3	1	1	1	1	1	2	2	2	3
Avg	2	2.2	2.6	2.4	2.8	1	1	1	1	1	1.8	1.8	2.2	2.4

ME3707	Title: Finite Element Method	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To understand the fundamental concepts of the theory of the finite element method.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction	7
Introduction to finite element method for solving field problems, stress and equilibrium, boundary conditions, strain, displacement, stress-strain relations. one dimensional problem: finite element equations, treatment of boundary conditions, galerkin's approach.		
Unit II	Analysis of Trusses and Frames	8
Element stiffness matrix for a truss member, analysis of plane truss with two at each node. Analysis of frames with two translations and a rotational degree of freedom at each node, analysis of beams: element stiffness matrix for two nodes (two degrees of freedom per node).		
Unit III	Finite Element Modeling	7
Finite element modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions. Finite element modeling of axi-symmetric solids subjected to axi-symmetric loading with triangular elements.		
Unit IV	Two Dimensional Analysis	7
Two dimensional four nodded iso-parametric elements and numerical integration. Steady state heat transfer analysis: one dimensional analysis of a fin and two dimensional analysis of thin plate, analysis of circular shaft subjected to torsion.		
Unit V	Dynamic Analysis	7
Formulation of finite element model, element matrices, evaluation of eigen values and eigen vectors for a stepped bar and a beam, time dependent field problems: application to one dimensional heat flow in a rod. Introduction to finite element formulation of three-dimensional problems in stress analysis, convergence requirements. Introduction to finite element analysis software.		
Text Books	1. G. Ramamurthy, Applied Finite Element Analysis, I.K. International Publishing House Pvt. Ltd., New Delhi, 2.Tirupathi R, Chandraputla and Ashok D Belagundu, Introduction to Finite Elements in Engineering, Practice Hall of India, . 3. S S Rao, The Finite Element Method in Engineering, Pergamon Press.	
Reference Books	1. L J Segerlind, Applied Finite Element Analysis, Wiley Eastern. 2. JN Reddy, An Introduction to Finite Element Method, McGraw-Hill.	
Mode of Evaluation	Internal and external examination	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME 3707

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should understand the concepts behind formulation methods in FEM.	2	Em
CO2	Students should be able to Identify the application and characteristics of FEA elements in truss and frames.	3	S
CO3	Students should develop element characteristic equation.	3	S
CO4	Students should be able to apply the FEM 2D concept on steady state heat transfer analysis.	3	S
CO5	Students should be able to understand dynamic analysis in different stepped bar and a beam, time dependent field problems.	2	S

CO-PO Mapping for ME3707

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	2	3	3	3	3	1	1	1	1	1	1	2	2	2
CO 2	2	3	2	2	2	1	1	1	1	1	1	2	2	2
CO 3	3	3	2	3	3	2	1	1	2	1	1	2	3	3
CO 4	3	3	2	3	3	1	1	1	1	1	1	2	2	2
CO 5	2	2	3	3	3	2	1	1	2	1	1	3	2	3
Avg	2.4	2.8	2.2	2.8	2.8	1.4	1	1	1.4	1	1	2.2	2.2	2.4

ME3708	Title: Mechanical Vibrations	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites	ME3402	
Objectives	To study the one and multi-degree-of-freedom systems. Natural frequencies and modes of vibrations, resonance, beat phenomenon, effect of damping, applications to practical problems, and methods to avoid excessive vibrations.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction	6
Periodic motion, harmonic motion, superposition of simple harmonic motions, beats, Fourier analysis. Single degree freedom system: free vibration, natural frequency, equivalent systems, energy method for determining natural frequency, response to an initial disturbance, torsional vibrations, damped vibrations. Damping models – structural, coulomb and viscous damping, vibrations of system with viscous damping, logarithmic decrement, viscous dampers.		
Unit II	Single Degree Freedom	8
Single degree freedom: forced vibration, harmonic excitation with viscous damping, steady state vibrations, forced vibrations with rotating and reciprocating unbalance, support excitation, vibration isolation, transmissibility, vibration measuring instruments- displacement, velocity, acceleration and frequency measuring instrument.		
Unit III	Two Degree Freedom System	8
Two degree freedom system: introduction, principal modes, double pendulum, torsional system with damping, coupled system, undamped dynamic, vibration absorbers, centrifugal pendulum absorber, dry friction damper, untuned viscous damper.		
Unit IV	Multidegree Freedom System	8
Multidegree freedom system: exact analysis undamped free and forced vibrations of multidegree system, influence numbers, reciprocal theorem, torsional vibration of multi rotor system, vibration of geared system, principal coordinates, continuous systems- longitudinal vibration of bars, torsional vibrations of circular shafts, lateral vibration of beams.		
Unit V	Multidegree Freedom System II	10
Multidegree freedom system: numerical analysis Rayleigh's, Dunkerley's, Holzer's and Stodola's methods, Rayleigh – Ritz method. Critical speed of shafts: shafts with one disc with and without damping, multi-disc shafts, secondary critical speed.		
Text Books	1. S.S Rao,Mechanical Vibrations, Pearson 2. V. Rama Murthy, Mechanical Vibration Practice with Basic Theory, Narosa Publishers	
Reference Books	1. W. T. Thomson , Theory of Vibration with Applications, PHI 2. M. L. James, G. M. Smith, J. G Wolford, P. W. Whaley, Vibration of Mechanical and Structural Systems, Harper Collins 3. Magreb, Mechanical Vibration, Cengage India, New Delhi 4. Palm, Mechanical Vibration, Wiley India, New Delhi	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME3708

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to develop an understanding of different types of motions and effect of damping.	3	Em
CO2	Students should be able to develop an understanding of single degree of freedom and vibration measuring instruments.		S
CO3	Students should be able to attain a theoretical understanding of Two Degree Freedom System and undamped dynamic.	3	S
CO4	Students should be able to develop an understanding of exact analysis undamped free and forced vibrations of multidegree system.	3	S
CO5	Students should be able to numerical analyze the Rayleigh's, Dunkerley's, Holzer's and Stodola's methods and Critical speed of shafts.	3	S

CO-PO Mapping for ME3708

Course Outcomes es	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	2	2	3	2	1	1	1	1	1	1	1	2	2	2
CO 2	3	3	2	3	2	1	1	1	1	1	1	2	2	2
CO 3	2	2	3	2	1	1	1	1	2	1	1	2	3	3
CO 4	2	2	2	2	1	1	1	1	1	1	1	2	2	3
CO 5	2	2	3	3	1	2	1	1	2	1	1	2	2	2
Avg	2.2	2.2	2.6	2.4	1.2	1.2	1	1	1.4	1	1	2	2.2	2.4

ME3709	Title: Waste Heat Recovery Systems	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	This course provides the knowledge about upcoming concept of waste heat recovery systems and cogeneration.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction	8
Introduction, principles of thermodynamics and second law, sources of waste heat recovery, diesel engines and power plant.technologies for waste heat recovery and utilization. Need of storage systems for waste heat, utilization of waste heat - continuous and intermittent. Selection criteria for waste heat recovery technologies.		
Unit II	Cogeneration	8
Principles of thermodynamics, combined cycles, topping, bottoming, organic rankin cycles, advantages of cogeneration technology,cogeneration application in various industries like cement, sugar mill, paper mill etc. Sizing of waste heat boilers, concept of tri generation		
Unit III	Applications	8
Recuperators, regenerators, economizers, plate heat exchangers, waste heat boilers-classification, location, service conditions, design considerations		
Unit IV	Application II	10
Unfired combined cycle ,supplementary fired combined cycle, fired combined cycle, applications in industries, fluidised bed heat exchangers, heat pipe exchangers, heat pumps, thermoelectric devices, utilization of low grade reject heat from power plants, calculation of heat losses, case studies.		
Unit V	Economics	10
Investment cost, economic concepts, measures of economic performance, procedure for optimization of system selection and design, load curves, sensitivity analysis. Regulatory and financial framework for cogeneration and waste heat recovery systems. Environmental considerations for cogeneration and waste heat recovery, pollution.		
Text Books	1. S Mukherjee, P Roy, Mechanical Sciences Engineering Thermodynamics and Fluid Mechanics, PrenticeHall, India 2. Srinivasan, Environmental Engineering, PHI	
Reference Books	1. Robert J Goldstick, Albert Thernman, The Waste Heat Recovery Handbook, Fairmont Press 2. Khartchenko N.V. Advanced Energy Systems, Taylor and Francis, Washington DC 3. Harvey D.L. Handbook on Low-Energy Buildings and District-Energy Systems, Earthscan.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME3709

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to develop an understanding of the basics of waste heat recovery systems.	2	Em
CO2	Students should be able to describe the basic thermodynamic principles of cogeneration,the cogeneration technologies based on the steam turbine, gas turbine, and IC engine.	2	S
CO3	Students should be able to attain a theoretical understanding of applications and issues related to waste heat recovery and cogeneration technologies.	2	S
CO4	Students should be able to classify thecommercially viable waste heat recovery devices along with their applications andassociated saving potential.	2	S
CO5	Students should be able to theoretically analyze the economic and environmental aspects ofwaste heat recovery systems and cogeneration.	2	S

CO-PO Mapping for ME3709

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	2	2	3	2	2	3	3	3	1	1	1	2	2	2
CO 2	2	3	2	3	2	2	2	2	1	1	1	2	2	2
CO 3	2	3	3	2	2	3	3	3	2	1	1	2	3	3
CO 4	3	3	2	2	2	3	3	3	1	1	1	2	2	2
CO 5	2	2	3	3	2	3	3	3	2	1	1	3	2	3
Avg	2.2	2.6	2.6	2.4	2	2.8	2.8	2.8	1.4	1	1	2.2	2.2	2.4

ME3710	Title: Heating Ventilation and Air-conditioning	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To know the process of designing a HVAC system to meet desired needs within realistic constraints.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction to HVAC	10
Scope of HVAC industry with overview of consulting & construction industry, concepts of air conditioning systems. Principles of air conditioning, refrigerant cycle, chilling system, cooling, heating, humidification methods, dehumidification methods, filtration, air-conditioning systems, local cooling comfort system, window air conditioning, split air conditioning, VRV- air conditioning, chilled water fan coil unit, central air conditioning system, chilled water system, psychometric chart, properties of air.		
Unit II	Heat Load Estimation	8
Basics of heat transfer in a building envelop, understanding of outdoor & indoor conditions, correction to outdoor temperature & indoor temperature requirements, exposure of wall, latitude of location, yearly range, daily range etc.Factors effecting the loads estimate, sources of heat gain, external- sun gain through glass/window, sungain through roof/wall, partition gain, internal - people, lights, electrical equipment, motors, kitchen appliances, heat gain through infiltration air, heat gain thorough ventilation & by-pass air, heat gain through ducts. Calculating RSH, RLH,OASH,OALH, GTH, ESHF, ADP, dehumidified CFM, heat loss calculations, basics of heat loss in a building envelop, sources of heat loss		
Unit III	Design of Air Distribution System	8
Components of air distribution system, types of ducts, duct fittings, dampers, types of diffusers, return air grill, flexible duct, flexible connector, end cap, sound attenuator etc., duct elbows selections, vanes location & number of vanes required, duct material calculation- gi sheet, total sheet required in kgs. Gauge of duct & thickness of gauge. Hanger spacing, hanger rod diameter and angle support size, duct designing methods, fixed velocity method, equal friction method, static regain method.		
Unit IV	Chilled Water system design	9
Introduction to chilled water system, hot water system, classification of chillers- as per evaporator, as per condenser,As per compressor, chiller arrangements, cooling tower arrangement, types of cooling tower & expansion tank connections, pumps required in chilled water system, production pumps, distribution pumps, pump classifications, chilled water system pipe designing		
Unit V	Equipment Selection	5
AHU&FCU classification and selection, package unit selection dx- chiller selection, condenser selection, cooling tower selection mixed air temperature HRF for open and closed compressor. Expansion tank selection		
Text Books	1. Siddhartha Yadav Sujit Mishra ,Heating, Ventilation and air-conditioning, Notion Press 2. C.P. Arora, Refrigeration and Air-conditioning, McGraw Hill	
Reference Books	1. T. E. Mull, HVAC Principles and Application Manual, McGraw-Hill 2. R, David Skaves Fundamentals of HVAC, , AHRI institute press 3. Byoger Legg ,Air-conditioning System Design, Buttorworth	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME3710

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to develop an understanding of the HVAC systems.	2	Em
CO2	Students should be able to describe the various heat load estimation.	2	S
CO3	Students should be able to attain a theoretical and design understanding of air distribution system.	2	S
CO4	Students should be able to understand and design pumps and chillers.	2	S
CO5	Students should be able to select right equipment in HVAC according to the requirement.	2	S

CO-PO Mapping for ME 3710

Course Outcomes es	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	2	2	3	2	2	1	1	1	1	1	1	2	2	2
CO 2	3	3	2	3	2	1	1	1	1	1	1	2	2	2
CO 3	3	2	2	2	2	2	1	1	1	1	1	2	3	3
CO 4	3	2	2	2	2	1	1	1	1	1	1	2	2	2
CO 5	2	2	3	3	2	2	1	1	2	1	1	3	2	3
Avg	2.6	2.2	2.4	2.4	2	1.4	1	1	1.2	1	1	2.2	2.2	2.4

ME3711	Title: Six Sigma and Applications	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To familiarize with the role of six sigma and its tools in improving the processes, products or any system in the organization.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction	5
Introduction to six sigma, meaning of sigma, relationship between quality and sigma level, success stories, benefits of six sigma, methodology, voice of customer, goal setting and measurements, problem solving and decision making, project charter		
Unit II	Measurement	8
Variability and its causes, sample statistics, graphical representation, basic tools, process mapping, probability, distribution curve, six sigma measurement, control charts, MSA, cause and effect matrix, QFD, FMEA		
Unit III	Process Capability and Analyze	10
Process capability analysis, visualization of data, confidence interval, hypothesis test, ANOVA, correlation and regression analysis		
Unit IV	Improve and Control	10
Design of experiments – classical, Taguchi and Shainin D.O.E, response surface methodology, alternate to control charts, pre-control charts, control plan, poka-yoke, realistic tolerancing, and project completion, reliability testing		
Unit V	Application and Integration	8
DFSS, case studies of six sigma, integration of six sigma with lean, theory of constraints.		
Text Books	1. Forrest W. Breyfogle III ,Implementing Six Sigma: Smarter Solutions using Statistical Method, John Wiley and Sons. 2. Thomas Pyzdek , The Six Sigma Handbook, McGraw Hill	
Reference Books	1. Dean H. Stamatis, Six Sigma Fundamentals: A Complete Guide to the System, Methods and Tools, Productivity Press 2. R.A. Fisher , The Design of Experiments, Oliver and Boyd	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME 3711

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to understand the basic concepts of six sigma.	2	Em
CO2	Students should be able to understant the measurement related basic tools and methods.	2	S
CO3	Students should be able to understand the terminologies and concepts related to process capability and its analysation.	2	S
CO4	Students should be able to solve the quality improvement problems in any industry through the various tools of six sigma.	2	S
CO5	Students should be able to understand the applications and cases studies related to six sigma.	2	S

CO-PO Mapping for ME3711

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)											Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	2	2	3	2	3	1	1	1	1	1	1	2	2	2
CO 2	3	3	2	3	2	1	1	1	1	1	2	2	2	2
CO 3	3	3	2	3	3	2	1	1	2	1	1	2	3	3
CO 4	2	2	2	1	3	1	1	1	1	1	2	2	2	2
CO 5	2	2	3	1	3	2	1	1	2	1	2	3	2	3
Avg	2.4	2.4	2.4	2	2.8	1.4	1	1	1.4	1	1.6	2.2	2.2	2.4

ME3712	Title: Quality Assurance and Management	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To make students understand and familiarize with the different quality tools and techniques.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction	5
Principles of quality management, quality gurus, quality cost, quality systems, customer orientation, benchmarking, reengineering, concurrent engineering		
Unit II	Practices of Quality Management	5
Leadership, organizational structure, team building, information system and documentation, quality auditing, ISO 9000, QS 9000		
Unit III	Tools and Techniques of Quality Management	8
Single vendor concept, JIT, quality function deployment, quality circles, TQM, 5S, Kaizen, SGA, POKAYOKE, Taguchi methods		
Unit IV	Statistical Quality Control	10
Methods and philosophy of statistical process control, control charts for variables and attributes, cumulative sum and exponentially weighted moving average control charts, other spc techniques, process capability analysis, six sigma accuracy		
Unit V	Acceptance Sampling	10
Acceptance sampling problems, single sampling plans for attributes, double, multiple and sequential sampling, military standards, the dodge-roming sampling plans		
Text Books	1. Mohammd Zairi, Total Quality Management for Engineers, Woodhead Publishing Limited 2. Douglus C. Montgomery, Introduction to Statistical Quality Control,John Wiley and Sons. 3. Dr. Ravi Shankar, Industrial Engineering and Management,Galgotia Publications Pvt. Ltd.	
Reference Books	1. Harvid Noori and Russel ,Productions and Operations Management – Total Quality and Responsiveness, McGraw Hill Inc. 2. Suresh Dalela and Sourabh ,ISO 9000: A Manual for Total Quality Management, ,S. Chand 3. John Ban , The Essence of Total Quality Management, PHI	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME3712

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to understand the prinicples of quality, quality assurance and management.	2	Em
CO2	Students should be able to understand the practices of qulaity management.	2	S
CO3	Students should be able to apply the tools and techniques of quality management.	3	S
CO4	Students should be able to demonstrate the ability to use the methods of statistical quality control.	3	S
CO5	Students should be able to understand sampling and its related terminology.	2	S

CO-PO Mapping for ME3712

Course Outcomes es	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	3	2	3	2	2	1	1	1	1	1	2	2	2	2
CO 2	2	3	2	1	2	1	1	1	1	1	2	2	2	2
CO 3	3	2	2	2	1	1	1	1	2	1	3	2	3	3
CO 4	2	2	2	1	2	1	1	1	1	1	2	2	2	2
CO 5	3	2	2	1	2	2	1	1	2	1	2	2	2	3
Avg	2.6	2.2	2.2	1.4	1.8	1.2	1	1	1.4	1	2.2	2	2.2	2.4

ME3713	Title: Unconventional Manufacturing Processes	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To make students aware of different nontraditional manufacturing processes and their applications.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction	7
Limitations of conventional manufacturing processes, need of unconventional manufacturing processes and its classification.		
Unit II	Unconventional Machining Process - I	7
Principle and working and applications of unconventional machining process such as Electro-Discharge machining, Electro-chemical machining, ultrasonic machining, Abrasive jet machining etc.		
Unit III	Unconventional Machining Process – II	7
Principle and working and application of unconventional machining processes such as laser beam machining, Electron beam machining, Ultrasonic machining etc.		
Unit IV	Unconventional Welding Process	7
Explosive welding, Cladding etc. Under water welding, Metallizing, Plasma are welding/cutting etc.		
Unit V	Unconventional Forming Process	8
Principle, working and applications of High energy forming processes such as Explosive Forming, Electromagnetic forming, Electro-Discharge forming, water hammer forming, explosive compaction etc.		
Text Books	1.P.C. Pandey, Modern Machining Processes, Tata McGraw Hill 2.Jagadeesha, Non-Traditional Machining Processes, IK Publishers	
Reference Books	1.G.F. Benedict, Non-Traditional Manufacturing Processes, CRC Press 2.V.K. Jain, Advanced Machining Processes, Allied Publisher	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME 3713

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to understand the need of non traditional machining processes and able to classify various processes.	2	Em
CO2	Students should be able to recognize the role of mechanical energy in non-traditional machining processes.	2	S
CO3	Students should be able to various on machining electrically conductive material through electrical energy in non-traditional machining processes.	2	S
CO4	Students should be able to perform process analysis considering the various responses considered in a process.	2	S
CO5	Students should be able to the use of controlled explosive and spark energy in deformation process.	2	S

CO-PO Mapping for ME 3713

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	2	2	3	2	3	1	1	1	1	1	1	2	2	2
CO 2	2	2	2	2	2	2	1	1	1	1	1	2	2	2
CO 3	3	2	3	2	3	2	1	1	1	1	1	2	3	3
CO 4	3	2	1	2	2	1	1	1	1	1	1	2	2	2
CO 5	2	2	3	3	3	2	1	1	1	1	1	2	2	3
Avg	2.4	2	2.4	2.2	2.6	1.6	1	1	1	1	1	2	2.2	2.4

ME3714	Title: Plastic Processing and Techniques	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To make students aware of various processing techniques of plastics and understand their applications.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Advanced Blow Molding Processes-I	7
Stretch blow molding: introduction, single stage & two stage processes and its comparison orientation and stretch ratio, pre-forming, extrusion stretch blow molding, injection orientation blow molding		
Unit II	Advanced Blow Molding Processes-II	7
Co-extrusion blow molding: co-extrusion equipment process, Miscellaneous blow molding processes**:** neck ring process drape process dip / displacement processes blow molding of irregular shaped parts		
Unit III	Advanced Extrusion Techniques	7
Advanced extruder machine features: twin screw extruder intermeshing and non-intermeshing counter rotating and co-rotating, comparison with single screw, vented screw extruder designs, internal bubble cooling. Co-extrusion: co-extrusion structures barrier materials & adhesives comparison, feed block die and multi manifold die advantages of co-extrusion products, applications of co-extruded products. Specialized processes: reinforced pipes- nylon braided pipes, hose pipe, fishing net, heat shrink film, cling film, corrugated sheets and pipes		
Unit IV	Advanced Injection Molding Processes-I	7
Reaction injection molding (rim): introduction to rim process, materials and additives, features of rim process and variables, machine & auxiliary, flow diagram of rim process, characteristic of rim parts, merits and demerits of rim process		
Unit V	Advanced Injection Molding Processes-II	8
Non-conventional injection molding process: material, process, advantages and disadvantages of the following processes, gas-assisted injection molding, sandwich injection molding, structural foam injection molding, flow molding, metal filled, multicolor molding, injection molding of reinforced thermoplastics		
Text Books	1. W.S.Allen,P N Baker, Handbook of Plastics Technology-Plastic Processing Operations Vol 1., CBS Hb.	
Reference Books	1. Edward Muccio, Plastic Processing Technology, ASM International 2. A Brent strong, Plastics:Materials and Processes, Prentice Hall	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME 3714

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to Understand the various types of PPEs and their usage in Plastic industry and non-conventional blow molding process.	2	Em
CO2	Students should be able to Co-extrusion blow molding displacement processes, blow molding of irregular shaped parts.	2	S
CO3	Students should be able to various screw designs used in extrusion plants, specialized extrusion processes for non-conventional extrusion product.	2	S
CO4	Students should be able to the Reaction injection molding (rim)and features of rim process and, characteristic of rim parts.	2	S
CO5	Students should be able to the use non-conventional injection molding techniques and injection molding of reinforced thermoplastics.	2	S

CO-PO Mapping for ME3714

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)											Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	3	2	3	2	2	2	2	1	1	1	1	2	2	2
CO 2	3	3	2	3	2	1	1	1	1	1	1	2	2	2
CO 3	3	2	3	2	2	2	1	1	1	1	1	2	3	3
CO 4	3	2	3	2	2	1	1	1	1	1	1	2	2	2
CO 5	2	2	3	3	1	2	1	1	1	1	1	2	2	3
Avg	2.8	2.2	2.8	2.4	1.8	1.6	1.2	1	1	1	1	2	2.2	2.4

SEMESTER 8

ME3801	Title: Solar and Thermal Power Engineering	L T P C 3 0 03
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To understand the basic concepts of the solar radiation and analyze the solar Thermal systems for their utilization as alternate energy source.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction	5
Energy demand growth and supply: historical perspectives; fossil fuels: consumption and reserve; environmental impacts of burning of fossil fuels; sustainable development and role of renewable energy sources.		
Unit II	Solar Energy	8
The sun as energy source and its movement in the sky; solar energy received on the earth; primary and secondary solar energy and utilization of solar energy. Characteristic advantages and disadvantages.		
Unit III	Solar Radiation and Measurement	8
Solar radiation on the earth surface, extraterrestrial radiation characteristics, terrestrial radiation, solar insulation, spectral energy distribution of solar radiation. Depletion of solar radiation, absorption, scattering. Beam radiation, diffuse and global radiation. Measurement of solar radiation, pyranometer, pyrheliometer, sunshine recorder. Solar time - local apparent time (LAT), equation of time (E).		
Unit IV	Solar Thermal Electricity Generation	9
Solar concentrators and tracking; dish and parabolic trough concentrating generating systems, central tower solar thermal power plants; solar ponds.		
Unit V	Solar Photovoltaic Systems	5
Basic principle of power generation in a PV cell: band gap and efficiency of PV cells, manufacturing methods of mono- and poly-crystalline cells, amorphous silicon thin film cells single and multi-junction cells, application of PV, brief outline of solar PV stand-alone system design, storage and balance ofsystem.		
Text Books	1.De Vos. A ,Thermodynamics of Solar Energy Conversion,Wiley-VCH 2.Prakash. J, Garg. H. P , Solar Energy Fundamentals and Applications, TataMcGraw-Hill	
Reference Books	1. Kalogirou. S ,Solar Energy Engineering, Processes and Systems,Elsevier 2. Petela. R, Engineering Thermodynamics of Thermal Radiation for Solar Power, McGraw- HillCo. 3. YogiGoswami.D,FrankKreith,JanF.Kreider,PrinciplesofSolarEngineering,Taylor& Francis 4. Andrews J., Jelley N , Energy Science, Oxford UniversityPress	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME3801

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Students should be able to Identify the renewable energy sources and their utilization.	2	Em
CO2	Students should be able to understand the different type of solar energy.	2	S
CO3	Students should be able to understand various concepts related to solar radiation and its measurement.	2	S
CO4	Students should be able to understand various concepts related to solar thermal electricity generation.	2	S
CO5	Students should be able to Understand the principle of working of solar cells and their modern manufacturing techniques	2	S

CO-PO Mapping for ME3801

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	2	2	3	2	3	3	3	2	1	1	1	2	2	2
CO 2	3	3	2	3	2	1	1	1	1	1	1	2	2	2
CO 3	3	2	3	2	3	2	1	1	1	1	1	2	3	3
CO 4	3	2	2	2	2	1	1	1	1	1	1	2	2	2
CO 5	2	2	2	2	2	2	1	1	1	1	1	3	2	3
Avg	2.6	2.2	2.4	2.2	2.4	1.8	1.4	1.2	1	1	1	2.2	2.2	2.4

ME3802	Title: Nuclear Power Engineering	L T P C 3 0 03
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To understand the systems, components and process adopted in generation of nuclear power along with safety and economic aspects.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction	8
Nuclear fission. Nuclear reactions and radiations – principles of radioactive decay interactions of an ray with matter – the fission process. Basic principles of controlled fusion. Nuclear reactor principles, criticality condition, basic features of reactor control. Principles of the conversion of nuclear energy to useful power, various types of nuclear power plant.		
Unit II	Nuclear Reactors	8
Boiling water reactor. Description of reactor system, main components, control and safety features. Materials of reactor construction – fuel, moderator, coolant, problems involving core hydrodynamics of boiling-water reactors, pressurized water reactor components, gas- cooled reactor cycles and components.		
Unit III	Nuclear Fuels	8
Structural materials, cladding, radiation damage, nuclear fuels: metallurgy of uranium, general principles of solvent extraction, reprocessing of irradiated fuel, separation process fuel enrichment.		
Unit IV	Heat removal and Economics aspects	8
Reactor heat removal/equations of heat transfer as applied to reactor cooling– reactor heat transfer systems – heat removed in fast reactors. Economics of nuclear power plants. Accounting for capital costs, fuel costs and O&M (operations and maintenance) costs, as well as environmental aspects - sustainability, proliferation, safety, relative merits of different types of powerplants.		
Unit V	Nuclear Radiation Safety	4
Radiation safety: reactor shielding – radiation dozes – standards of radiation protection, nuclear plant safety-safety systems-changes and consequences of accident-criteria for safety-nuclear waste types of waste and its disposal-radiation hazards and their prevention-weapons proliferation		
Text Books	1. G.Vaidyanathan,NuclearReactorEngineering-PrinciplesandConcepts,S.Chand Publishers 2. M. M. El-Wakil , Nuclear Power Engineering, Mc GrawHill	
Reference Books	1. JohnR.Lamarshand AnthonyJ.Baratta,IntroductiontoNuclearEngineering,Prentice Hall. 2. John Lee, Nuclear Reactor Physics and Engineering,Wiley	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME3802

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student should be able to Know about the Nuclear fission, reactor control	2	Em
CO2	Student should be able to Know about the Nuclear Reactors	2	S
CO3	Student should be able to Know about the Nuclear Fuels	2	S
CO4	Student should be able to Know about the Heat removal and Economics aspects	2	S
CO5	Student should be able to learn about the Nuclear Radiation Safety	2	S

CO-PO Mapping for ME3802

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	2	2	3	2	3	1	1	1	1	1	1	2	2	2
CO 2	3	3	2	3	2	1	1	1	1	1	1	2	2	2
CO 3	3	2	3	2	3	2	1	1	2	1	2	2	3	3
CO 4	3	2	2	2	3	1	1	1	1	1	1	2	2	2
CO 5	2	2	3	3	3	2	1	1	2	1	2	3	2	3
Avg	2.6	2.2	2.6	2.4	2.8	1.4	1	1	1.4	1	1.4	2.2	2.2	2.4

ME3803	Title: Supply Chain Management	L T P C 3 0 03
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To provide the student with an understanding of the tools and techniques useful in implementing supply chain management in a business.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction	8
Historical perspective, objective and importance of supply chain, decision phases in supply chain, examples, supply chain performance, supply chain drivers and metrics.		
Unit II	Planning Demand and Supply in a Supply Chain	10
Demand forecasting in supply chain, aggregate planning in supply chain, planning supply and demand; managing predictable variability, economic order quantity models, reorder point models, multi-echelon inventory systems.		
Unit III	Planning and Managing inventories in a Supply Chain	8
Managing economies of supply chain, managing uncertainty in a supply chain, determining optimal levels of product availability.		
Unit IV	Transportation, Network Design and Information Technology	8
Transportation aspects in a supply chain, facility decision, network design in a supply chain, information technology and its use in supply chain		
Unit V	Coordination in Supply Chain and effect of E-Business:	6
Role of coordination and e- business in a supply chain; financial evaluation in a supply chain.		
Text Books	1. Chopra and Meindl ,Supply Chain Management, PearsonEducation. 2. Janat Shah, Supply Chain Management, PearsonEducation.	
Reference Books	1. Bowersox, Closs, Cooper , Supply Chain Logistics Management, McGrawHill. 2. Mohanty R.P, S.G Deshmuki, Supply Chain Management, Biztantra, NewDelhi	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME3803

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student should be able to Know about the objective and importance of supply chain	2	Em
CO2	Student should be able to Know about thePlanning Demand and Supply in a Supply Chain	2	S
CO3	Student should be able to Know about the Planning and Managing inventories in a Supply Chain	2	S
CO4	Student should be able to Know about the Transportation, Network Design and Information Technology	2	S
CO5	Student should be able to learn about the Coordination in Supply Chain and effect of E-Business	2	S

CO-PO Mapping for ME 3803

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	2	2	2	2	2	1	1	1	1	1	2	2	2	2
CO 2	2	3	2	3	2	1	1	1	1	1	3	2	2	2
CO 3	2	2	3	2	1	2	1	1	2	1	3	2	3	2
CO 4	2	2	2	2	1	2	1	1	1	1	2	2	2	3
CO 5	2	2	2	3	1	2	1	1	2	1	2	3	2	3
Avg	2	2.2	2.2	2.4	1.4	1.6	1	1	1.4	1	2.4	2.2	2.2	2.4

ME3804	Title: Value Engineering	L T P C 3 0 03
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	This course provides the knowledge about the value analysis, its techniques and applications.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction to Value Analysis	6
Definition of value, value analysis, value engineering, value management, value analysis versus value engineering, value analysis versus traditional cost reduction techniques, uses, applications, advantages and limitations of value analysis. Symptoms to apply value analysis, coaching of champion concept. Types of values: reasons for unnecessary cost of product, peeling cost onion concept, unsuspected areas responsible for higher cost, value analysis zone, attractive features of value analysis. Meaning of value, types of value & their effect in cost reduction. Value analysis procedure by simulation. Detailed case studies of simple products.		
Unit II	Functional Cost and its Evaluation	6
Meaning of function and functional cost, rules for functional definition, types of functions, primary and secondary functions using verb and noun, function evaluation process, methods of function evaluation. Evaluation of function by comparison, evaluation of interacting functions, evaluation of function from available data, matrix technique, miss technique, numerical evaluation of functional relationships and case studies.		
Unit III	Value Engineering Job Plan and Techniques	8
Meaning and importance of value engineering job plan. Phases of job plan proposed by different value engineering experts, information phase, analysis phase, creative phase, judgement phase, development planning phase, and case studies. Cost reduction programs, criteria for cost reduction program, value analysis change proposal. Result accelerators or new value engineering techniques, listing, role of techniques in value engineering, details with case examples for each of the techniques.		
Unit IV	Advanced Value Analysis Techniques	8
Functional analysis system technique and case studies, value analysis of management practice (VAMP), steps involved in vamp, application of VAMP to government, university, college, hospitals, school problems etc., (service type problems).		
Unit V	Total Value Engineering and Applications	8
Total value engineering: concepts, need, methodology and benefits. Application of value analysis: application of value analysis in the field of accounting, appearance design, cost reduction, engineering, manufacturing, management, purchasing, quality control, sales, marketing, material management etc.,		
Text Books	1. Lawrence D. Miles, Techniques of Value Analysis and Engineering, McGraw Hill BookCompany 2. Anil Kumar Mukhopadhyaya, Value Engineering: Concepts Techniques and applications, SAGE Publications	
Reference Books	1. Warren J Ridge, Value Analysis for Better Management, American Management Association 2. G.Jagannathan, Getting More at Less Cost (The Value Engineering Way), Tata Mcgraw Hill Pub.Comp 3. Arther E Mudge, Value Engineering, McGraw Hill BookComp	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME3804

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student should be able to understand about Introduction to Value Analysis	2	Em
CO2	Student should be able to understand about Functional Cost and its Evaluation	2	S
CO3	Student should be able to know about Value Engineering Job Plan and Techniques	2	S
CO4	Student should be able to understand about Advanced Value Analysis Techniques	2	S
CO5	Student should be able to know about the Total Value Engineering and Applications	2	S

CO-PO Mapping for ME3804

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	2	2	3	2	3	1	1	2	2	1	1	2	2	3
CO 2	2	3	2	3	2	1	1	3	2	1	1	2	3	2
CO 3	2	2	3	2	3	2	1	2	2	1	1	2	2	2
CO 4	2	2	2	2	3	1	1	3	3	1	1	2	2	2
CO 5	2	2	3	3	3	2	1	3	2	1	1	3	2	2
Avg	2	2.2	2.6	2.4	2.2	1.4	1	2.6	2.2	1	1	2.2	2.2	2.2

MT3803	Title: Robotics and Automation	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To understand the engineering aspects of 3D translation, orientation representation arm, Automation and ROS concept.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction	5
Definitions, types of robots, application of robots, representing position and orientation, representing pose in 2 dimensions, representing pose in 3 dimensions, representing orientation in 3 dimensions, combining translation and orientation.		
Unit II	Trajectories Motion and Automation	6
Trajectories, smooth one-dimensional trajectory, multi-dimensional case, multi segment trajectories, interpolation of orientation in 3d, cartesian motion, time varying coordinate frames, rotating coordinate frame, incremental motion, inertial navigation systems, mobile robot vehicles, mobility, car like mobile robots, moving to a point, following a line, following a path, moving to a pose.		
Unit III	Robot Navigation and Automation	7
Reactive navigation, Braitenberg vehicles, simple automata, map based planning, distance transform, Veronai roadmap method, probabilistic roadmap method, localization, dead reckoning, modeling the vehicle, estimating pose, using a map, creating a map, localization and mapping, monte Carlolocalization.		
Unit IV	Robot Arm Kinematics	7
Describing a robot arm, forward kinematics, a 2 link robot, a 6 axis robot, inverse kinematics, closed form solution, numerical solution, under actuated manipulator, redundant manipulator, joint space motion, cartesian motion, cylindrical motion, spherical motion, SCARA motion, articulated motion, motion through a singularity.		
Unit V	Getting Started with ROS	5
Installing ROS, understanding the ROA file system level, packages, stacks, messages, services, understanding the ROS computation graph level, nodes, topics, services, messages, bags, master, parameter server, creating workspace, creating & building an ros package, creating & building the node, visualization of images, working with stereo vision, 3d visualization, visualizing data on a 3d world using rviz.		
Text Books	1. John J. Craig, Introduction to Robotics, AddisonWesley 2. M. P. Grover, Automation, Production Systems and Computer Integrated Manufacturing, PearsonEducation. 3. Aaron Martinez & Enrique Fernández, Learning ROS for RoboticsProgramming, Packt Publishing	
Reference Books	1. Yoram Koren, Robotics for Engineers, McGraw HillInternational 2. Groover, Weiss, Nagel, Industrial Robotics, McGraw HillInternational 3. Fu, Lee and Gonzalez, Robotics, control vision and intelligence. McGraw Hill International 4. Saeed B. Niku, Introduction to Robotics – Analysis, Systems and Application, John Wiley & SonsInc.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome For MT3803

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student should be able to understand the basic concepts of Definitions,	2	Em
CO2	Student should be able to understand the types of robots	2	S
CO3	Student should be able to understand the Trajectories Motion and Automation, Robot Navigation and Automation	2	S
CO4	Student should be able to analyze Robot Arm Kinematics	2	S
CO5	Student should be able to know and apply concepts of ROS	2	S

CO-PO Mapping for MT 3803

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	2	2	2	2	3	1	1	1	1	1	1	2	2	3
CO 2	2	3	2	3	2	1	1	1	1	1	1	3	3	3
CO 3	2	2	2	2	3	1	1	1	2	1	1	2	3	3
CO 4	2	2	2	2	3	1	1	1	1	1	1	3	2	2
CO 5	2	2	2	3	3	1	1	1	2	1	1	3	2	3
Avg	2	2.2	2	2.4	2.8	1	1	1	1.4	1	1	2.6	2.4	2.8

ME3806	Title: Rapid Prototyping	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites		
Objectives	To make students aware of different types of Rapid prototyping processes, materials used in RPsystems and reverse engineering.	
Unit No.	Unit Title	No. of hours(per Unit)
Unit I	Introduction	7
History, development of RP systems, applications in product development, need for the compression in product development, classification of RP, rapid tooling, rapid manufacturing- principle – fundamental – file format, data files and data formats. Data preparation.		
Unit II	Reverse Engineering and New Technologies	7
Introduction, measuring device- contact type and non-contact type, CAD model creation from point clouds-preprocessing, point clouds to surface model creation, medical data processing – types of medical imaging, software for making medical models, medical materials, other applications – Case study.		
Unit III	Materials for Rapid Prototyping Systems	7
Nature of material – type of material – polymers, metals, ceramics and composites- liquid based materials, photo polymer development – solid based materials, powder-based materials – case study.		
Unit IV	Liquid and Solid Based Rapid Prototyping Systems	7
Classification – Liquid based system – Stereolithography Apparatus (SLA), details of SL process, products, Advantages, Limitations, Applications and Uses. Solid based system – Fused Deposition Modeling, principle, process, products, advantages, applications and uses – Laminated Object Manufacturing.		
Unit V	Powder Based Rapid Prototyping Systems	8
Selective Laser Sintering – principles of SLS process, principle of sinter bonding process, Laser sintering materials, products, advantages, limitations, applications and uses. Three-Dimensional Printing – process, major applications, research and development. Direct shell production casting – key strengths, process, applications and uses, case studies, research and development. Laser Sintering System, e-manufacturing using Laser sintering, customized plastic parts, customized metal parts, e-manufacturing – Laser Engineered Net Shaping (LENS).		
Text Books	1. Rafiq I. Noorani, Rapid Prototyping, Principles and Applications, Wiley &Sons, 2. Chua C.K, Leong K.F and Lim C.S, Rapid Prototyping: Principles and Applications, WorldScientific,	
Reference Books	1. N. Hopkinson, R.J.M, Hauge, P M, Dickens,Rapid Manufacturing – An Industrial revolution forthe digital age,Wiley, 2. Ian Gibson , Advanced Manufacturing Technology for Medical applications: Reverse Engineering, Software conversion and Rapid Prototying,Wiley, 3. Paul F. Jacobs, Rapid Prototyping and Manufacturing: Fundamentals of Stereolithography, McGrawHill 4. Pham. D.T., and Dimov. S. S, Rapid Manufacturing, SpringerVerlog.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome For ME3806

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student should be able to understand about development of RP systems	2	Em
CO2	Student should be able to understand about Reverse Engineering and New Technologies	2	S
CO3	Student should be able to know about Materials for Rapid Prototyping Systems	2	S
CO4	Student should be able to understand about Liquid and Solid Based Rapid Prototyping Systems	2	S
CO5	Student should be able to know about the Powder Based Rapid Prototyping Systems	2	S

CO-PO Mapping for ME 3806

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	2	2	3	2	3	1	1	1	1	1	1	2	2	2
CO 2	3	3	2	3	2	1	1	1	1	1	1	2	2	2
CO 3	3	2	3	2	3	2	1	1	2	1	2	2	3	3
CO 4	3	2	2	2	3	1	1	1	1	1	1	2	2	2
CO 5	2	2	3	3	3	2	1	1	2	1	2	3	2	3
Avg	2.6	2.2	2.6	2.4	2.8	1.4	1	1	1.4	1	1.4	2.2	2.2	2.4

ME3807	Title: Energy Conservation and Audit	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	This course provides the knowledge of energy conservation measures in thermal and electrical energy systems.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Energy conservation	6
Principles of energy conservation, energy conservation planning, energy conservation in small scale industries, large scale industries and in electrical generation, transmission and distribution, energy conservation legislation.		
Unit II	Energy Audit	8
Aim of energy audit, strategic of energy audit, energy management team consideration in implementing energy conservation programme, instruments for energy audit, energy audit of electrical systems, HVAC, buildings, economic analysis.		
Unit III	Demand Side Management	6
Concept and scope of demand side management, evolution of demand side management, DSM strategy, planning, implementation and itsapplication, customer acceptance & its implementation issues, national and international experiences with DSM.		
Unit IV	Voltage and Reactive power in Distribution Systems	8
Voltage and reactive power calculations and control, voltage classes and nomenclature, voltage drop calculations, voltage control, VAR requirements and power factor, capacitors unit and bank rating, protection of capacitors and switching, controls for switched capacitorsand fields testing.		
Unit V	Efficiency in Motors and Lighting system	8
Load scheduling/shifting, motor drives-motor efficiency testing, energy efficient motors, and motor speed control. Lighting- lightinglevels, efficient options, fixtures, day lighting, timers, energy efficient windows, ups selection, installation operation andmaintenance. Indian Electricity Act 1956, Distribution Code and Electricity Bill 2003.		
Text Books	1. Tripathy S.C, Electric Energy Utilization and Conservation, , Tata McGrawHill. 2. I. G. C. Dryden, The Efficient Use of Energy, Butterworths,London	
Reference Books	1. W. C. Turner , Energy Management Handbook, Wiley, NewYork 2. L. C. Witte, P. S. Schmidt, D. R. Brown Industrial Energy Management and Utilization, Hemisphere Publ, Washington 3. Recommended Practice for Energy Conservation and cost effective planning in industrialfacilities, IEEE Bronze Book, IEEEPress	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Board of Studies on	13-06-2019	
Date of approval by theAcademic Council	13-07-2019	

Course Outcome for ME3807

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student should be able to understand about Energy conservation	2	Em
CO2	Student should be able to understand about Energy Audit	2	S
CO3	Student should be able to know about Demand Side Management	2	S
CO4	Student should be able to understand about Voltage and Reactive power in Distribution Systems	2	S
CO5	Student should be able to know about the Efficiency in Motors and Lighting system	2	S

CO-PO Mapping for ME 3807

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related-0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	2	2	3	2	3	2	2	1	1	1	1	2	2	2
CO 2	3	3	2	3	2	2	3	1	1	1	2	2	2	2
CO 3	3	2	3	2	3	2	3	2	1	1	1	2	3	3
CO 4	3	2	2	2	3	3	3	1	1	1	1	2	2	2
CO 5	2	2	3	3	3	3	3	1	1	2	2	3	2	3
Avg	2.6	2.2	2.6	2.4	2.2	2.4	2.8	1.2	1	1.2	1.4	2.2	2.2	2.4

ME3808	Title: Energy Storage System	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To enable the student to understand the need for energy storage, devices and technologies available andtheir applications	
Unit No.	Unit Title	No. of hours(per Unit)
Unit I	Electrical Energy Storage Technologies	10
Characteristics of electricity, electricity and the roles of EES, high generation cost during peak-demand periods, need for continuousand flexible supply, long distance between generation and consumption, congestion in power grids, transmission by cable.		
Unit II	Need	8
Emerging needs for ees, more renewable energy, less fossil fuel, smart grid uses, the roles of electrical energy storage technologies, the roles from the viewpoint of a utility, the roles from the viewpoint of consumers, the roles from the viewpoint of generators of renewableenergy.		
Unit III	Features	8
Classification of EES systems, mechanical storage systems, pumped hydro storage (PHS), compressed air energy storage (CAES), flywheel energy storage (FES),electrochemical storage systems, secondary batteries, flow batteries, chemical energy storage, hydrogen (H2),synthetic natural gas (SNG)		
Unit IV	Renewable Energy Systems	9
Solar energy, wind energy, pumped hydro energy, fuel cells. Energy storage in microgrid and smart grid. Energy management withstorage systems, battery SCADA, increase of energy conversion efficiencies by introducing energy storage.		
Unit V	Other Systems	5
Simulation of energy storage systems and its management, smart park, electric vehicle charging facility, HESS in microgrid andsmart grid, microbial fuel cell, hydrogen fuel cell.		
Text Books	1. A. R. Pendse , Energy Storage Science and Technology, SBS Publishers & Distributors Pvt. Ltd.,New Delhi	
Reference Books	1. JimEyer,GarthCorey,EnergyStoragefor theElectricityGrid:BenefitsandMarket PotentialAssessment Guide, , Sandia NationalLaboratories, 2. A.G. Ter Gazarian, Energy Storage for Power Systems, The Institution of Engineering andTechnology (IET) Publication,UK,	
Mode of Evaluation	Internal and External Examinations	
Recommendation byBoard of Studies on	13-06-2019	
Date of approval by theAcademic Council	13-07-2019	

Course Outcome for ME3808

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student should be able to understand the basic concepts of Electrical Energy Storage Technologies	2	Em
CO2	Student should be able to understand the Emerging needs for ees	2	S
CO3	Student should be able to understand the Classification of EES systems	2	S
CO4	Student should be able to analyze the Renewable Energy Systems Simulation of energy storage systems and its management	2	S
CO5	Student should be able to know smart park, electric vehicle charging facility, HESS in microgrid and smart grid, microbial fuel cell, hydrogen fuel cell.	2	S

CO-PO Mapping for ME 3808

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2, Low-1, Not related- 0)												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	2	2	3	2	3	3	2	2	1	1	1	2	2	2
CO 2	2	3	2	3	2	2	3	1	1	1	1	2	2	2
CO 3	3	2	3	2	3	3	2	1	1	1	1	2	3	3
CO 4	2	2	2	2	3	2	2	1	1	1	1	2	2	2
CO 5	2	2	3	3	2	3	3	2	1	1	1	2	2	3
Avg	2.2	2.2	2.6	2.4	2.6	2.6	2.4	1.4	1	1	1	2	2.2	2.4

ME3809	Title: Product Design and Development	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites		
Objectives	To provide students with a set of tools and methods for product design and development and make students aware of the role of multiple functions in creating a new product.	
Unit No.	Unit Title	No. of hours(per Unit)
Unit I	Design Fundamentals	7
The importance of engineering design, types of design, the design process, relevance of product lifecycle issues in design, designingto codes and standards- societal considerations in engineering design, generic product development process, various phases of product development, planning for products, establishing markets, market segments, relevance of market research		
Unit II	Customer oriented design & Societal Considerations	7
Identification of customer needs, customer requirements, quality Function Deployment Product Design Specifications-Human Factors in Design, Ergonomics and Aesthetics. Societal consideration, Contracts, Product liability, Protecting intellectual property, Legal and ethical domains, Codes of ethics, Ethical conflicts, Environment responsible design, future trends in interactionof engineering with society.		
Unit III	Material selection processing and Design	7
Material Selection Process, Economics, Cost Vs Performance, Weighted property Index, Value Analysis, Role of Processing inDesign, Classification of Manufacturing Process, Design for Manufacture, Design for Assembly, Designing for castings, Forging, Metal Forming, Machining and Welding, Residual Stresses, Fatigue, Fracture and Failure.		
Unit IV	Design Methods	7
Creativity and problem solving- creative thinking methods- generating design concepts, systematic methods for designing, functionaldecomposition, physical decomposition, functional representation, morphological methods, TRIZ, axiomatic design. decision making theory- utility theory, decision trees, concept evaluation methods.		
Unit V	Industrial Design concepts	8
Human factors design, user friendly design, design for serviceability, design for environment, prototyping and testing, cost evaluation, categories of cost, overhead costs, activity based costing, methods of developing cost estimates, manufacturing cost,value analysis in costing.		
Text Books	1. Kari T. Ulrich and Steven D. Eppinger, Product Design and Development, McGraw Hill International Edns.	
Reference Books	1. Kemnneth Crow, Concurrent Engg. Integrated Product Development, DRM Associates,Workshop Book. 2. Stephen Rosenthal, Effective Product Design and Development, Business One Orwin, Homewood 3. Staurt Pugh , Tool Design Integrated Methods for Successful Product Engineering, AddisonWesley Publishing, New York,NY.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Boardof Studies on	13-06-2019	
Date of approval by theAcademic Council	13-07-2019	

Course Outcome for ME3809

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student should be able to understand about Design Fundamentals Customer oriented design & Societal Considerations	2	Em
CO2	Student should be able to understand about Material selection processing and Design	2	S
CO3	Student should be able to know about Design Methods Industrial Design concepts	2	S
CO4	Student should be able to understand about Design Methods	2	s
CO5	Student should be able to know about the Industrial Design concepts	2	s

CO-PO Mapping for ME 3809

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3,Moderate-2, Low-1, Notrelated-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	2	2	1	1	1	3	1	1	1	1	1	2	2	2
CO2	3	3	1	1	1	2	1	1	1	1	1	2	2	2
CO3	3	2	1	1	1	3	2	1	2	1	2	2	3	3
CO4	3	2	1	1	1	2	1	1	1	1	1	2	2	2
CO5	2	2	1	1	1	3	2	1	2	1	2	2	2	3
Avg	2.6	2.2	1	1	1	2.6	1.4	1	1.4	1	1.4	2	2.2	2.4

ME3810	Title: Lean Manufacturing	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	This course is designed to provide the students the complete insights of various lean tools, techniques and lean implementation strategies.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction to Lean Manufacturing	7
Conventional manufacturing versus lean manufacturing, principles of lean manufacturing, lean manufacturing concepts, basic elements of lean manufacturing, introduction to LM tools.		
Unit II	Cellular Manufacturing, JIT and TPM	7
Cellular manufacturing – types of layout, principles of cell layout, implementation. JIT – principles of JIT and implementation of Kanban. TPM – pillars of TPM, principles and implementation of TPM.		
Unit III	Set up time reduction, TQM, 5S, VSM	7
Set up time reduction – definition, philosophies and reduction approaches, TQM – principles and implementation, 5s principles and implementation, value stream mapping - procedure and principles.		
Unit IV	Lean Manufacturing Implementation	8
Various lean implementation frameworks, steps for lean manufacturing implementation, enablers and barriers oflean implementation, case study-various case studies of implementation of lean manufacturing at industries.		
Unit V	Six Sigma	7
Definition, statistical considerations, variability reduction, design of experiments, six sigma implementations.		
Text Books	1. N. Gopalkrishnan, Simplified Lean Manufacture, PHI Learning Private Limited.New Delhi 2. Hobbs, D.P, Lean Manufacturing implementation, NarosaPublisher	
Reference Books	1. Lonnie Wilson, How to Implement Lean Manufacturing, McGrawHill. 2. William M. Feld, Lean Manufacturing: Tools, Techniques and How to Use Them, The StLuciePress. 3. Devadasan S.R, Lean and Agile Manufacturing: Theoretical, Practical and Research Futurities,PHI 4. Michael L. George , Lean Six Sigma,McGraw-Hill.	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Boardof Studies on	13-06-2019	
Date of approval by theAcademic Council	13-07-2019	

Course Outcome for ME3810

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student will be able to understand principles about lean manufacturing and importance	2	Em
CO2	Student will be able to know about JIT and TPM principles and implementation technques	2	S
CO3	Student will be able to know about TQM,5S and VSM procedure and principles	2	S
CO4	Student will be able to know implementation technique of Lean manufacturing	2	S
CO5	Student will be able to know about significance of six sigma	2	S

CO-PO Mapping for ME 3810

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3,Moderate-2, Low-1, Notrelated-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	3	2	3	1	1	1	1	1	1	2	2	2
CO2	1	3	2	3	2	1	1	1	1	1	1	2	2	2
CO3	1	2	3	2	3	2	1	1	2	1	2	2	3	3
CO4	1	2	2	2	3	1	1	1	1	1	1	2	2	2
CO5	1	2	3	3	3	2	1	1	2	1	2	3	2	3
Avg	1	2.2	2.6	2.4	2.2	1.4	1	1	1.4	1	1.2	2.2	2.2	2.4

ME3811	Title: Introduction to Tribology	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To provide the knowledge and importance of tribology in design, friction, wear and lubricationaspects of machine components	
Unit No.	Unit Title	No. of hours(per Unit)
Unit I	Surfaces and Friction	7
Introduction to the concept of tribology, tribological problems, nature of engineering surfaces, surface topography. Surface profilometer, measurement of surface topography. Contact between surfaces, sources of sliding friction, friction due to ploughing, friction due to adhesion friction characteristics of metals and non-metals, sources of rolling friction, stick slip motion. Frictionof ceramic materials and polymers, measurement of friction.		
Unit II	Wear	7
Wear and types of wear, simple theory of sliding wear mechanism, abrasive wear, adhesive wear, corrosive wear, and surface fatiguewears situations, wear of ceramics, wear of polymers, wear measurements.		
Unit III	Film Lubrication Theory	8
Coefficient of viscosity, fluid film in simple shear, viscous flow between very close parallel plate, lubricant supply, lubricant flow rate, cold jacking, Couette flow, cavitations, film rupture, oil whirl, shear stress variation within the film, lubrication theory byOsborne Reynolds, pressure fields for full Sommerfeld, half Sommerfeld, Reynolds boundary conditions.		
Unit IV	Lubricants and Lubrication Types	7
Types of lubricants, properties of lubricants, testing methods, hydrodynamic lubrication, elasto-hydrodynamic lubrication,hydrostatic lubrication.		
Unit V	Surface Engineering and Materials for Bearings	7
Classification of surface modifications and surface coatings, surface modifications, transformation hardening, surface modifications, surface fusion, thermo chemical processes, surface coatings, materials for rolling element bearings, materials for fluid film bearings, materials for marginally lubricated and dry bearings.		
Text Books	1. Hutchings. I. M, Edward, Tribology, Friction and Wear of EngineeringMaterial, Arnold,London, 2. Williams. J. A., Engineering Tribology, Oxford UniversityPress,	
Reference Books	1. Stolarski T.A , Tribology in Machine Design,., Industrial PressInc. 2. Cameron A, Basic Lubrication Theory, Longman,U.K. 3. Neale M. J., Newnes, Tribology Handbook, Butter worth,Heinemann, 4. Gwidon Stachowiak, Andrew W Batchelor, Engineering tribology, Elsevier Butterworth –Heinemann,USA	
Mode of Evaluation	Internal and External Examinations	
Recommendation by Boardof Studies on	13-06-2019	
Date of approval by theAcademic Council	13-07-2019	

Course Outcome For ME3811

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student will know about tribology issues in surfaces due to friction	2	S
CO2	Student will know about wear and its types	2	S
CO3	Student will know about film lubrication theory in tribology	2	S
CO4	Student will be able to know about lubricants and lubrication types	2	S
CO5	Student will be able to understand about concepts of surface engineering	2	S

CO-PO Mapping for ME 3811

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate-2, Low-1, Notrelated-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	3	1	1	1	1	1	1	2	2	2
CO2	3	3	1	3	2	1	1	1	1	1	2	2	2	2
CO3	3	2	1	2	2	2	1	1	2	1	1	2	3	3
CO4	3	2	2	2	2	1	1	1	1	1	1	2	2	2
CO5	2	2	2	3	2	2	1	1	2	1	2	3	2	3
Avg	2.6	2.2	1.4	2.4	2.2	1.4	1	1	1.4	1	1.4	2.2	2.2	2.4

ME3812	Title: Automotive Pollution and Control	L T P C 3 0 0 3
Version No.	1.0	
Course Prerequisites	Nil	
Objectives	To impart knowledge of various automotive pollution constituents and control techniques.	
Unit No.	Unit Title	No. of hours (per Unit)
Unit I	Introduction	6
Pollutants, sources, formation, effects of pollution on environment, human, transient operational effects on pollution,regulated, unregulated emissions, emission standards.		
Unit II	Emissions in SI Engine	8
Chemistry of SI engine combustion, HC and CO formation in SI engines, NO formation in SI engines, smoke emissionsfrom SI engines, effect of operating variables on emission formation.		
Unit III	Emissions in CI Engine	9
Basics of diesel combustion, smoke emission and its types in diesel engines, NOx emission and its types from diesel engines, particulate emission in diesel engines. odor, sulfur and aldehyde emissions from diesel engines, effect of operating variables on emission formation.		
Unit IV	Control Techniques for Reduction of Emission	9
Design modifications, optimization of operating factors, fuel modification, evaporative emission control, Exhaust gas recirculation, DOC, SCR, fumigation, secondary air injection, PCV system, particulate trap, CCS, exhaust treatment in SI engines, thermal reactors, catalytic converters, catalysts, use of unleaded petrol.		
Unit V	Test Procedure, Instrumentation and Emission Measurement	8
Test procedures CVS1, CVS3, Test cycles, IDC, ECE Test cycle, FTP Test cycle, NDIR analyzer, flame ionizationdetectors, chemiluminescent analyzer, dilution tunnel, gas chromatograph, smoke meters, SHED test.		
Text Books	1. Pundir. B.P, IC Engines Combustion and Emissions, NarosaPublishers, 2. Springer and Patterson, Engine Emission, PlenumPress,	
Reference Books	1. Automobiles and Pollution SAETransaction, 2. Ganesan V., Internal Combustion Engines, Tata McGraw HillCo., 3. Heywood, J. B., Internal Combustion Engine Fundamentals, McGraw Hill BookCo.,	
Mode of Evaluation	Internal and External Examinations	
Recommendation byBoard of Studies on	13-06-2019	
Date of approval by the Academic Council	13-07-2019	

Course Outcome for ME3812

Unit-wise Course Outcome	Descriptions	BL Level	Employability (Em)/ Skill(S)/ Entrepreneurship (En)/ None (*Use , for more than One*)
CO1	Student should be able to understand about Pollutants, sources	2	Em
CO2	Student should be able to understand about Emissions in SI Engine	2	S
CO3	Student should be able to know about Emissions in CI Engine	2	S
CO4	Student should be able to understand about Control Techniques for Reduction of Emission	2	S
CO5	Student should be able to know about the Test Procedure, Instrumentation and Emission Measurement	2	S

CO-PO Mapping for ME3812

Course Outcomes	Program Outcomes (Course Articulation Matrix (Highly Mapped- 3, Moderate- 2,Low-1,Notrelated-0)												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	1	1	1	1	1	1	1	2	2	2
CO2	3	3	2	2	2	2	1	1	1	1	1	2	2	2
CO3	3	2	2	2	1	2	2	1	2	1	2	2	3	3
CO4	3	2	2	2	1	2	2	1	1	2	1	2	2	2
CO5	2	2	2	2	1	3	3	2	2	1	2	3	3	3
Avg	2.6	2.2	2	2	1.2	2	1.8	1.2	1.4	1.2	1.4	2.2	2.4	2.4