DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY

CIRCULAR NO.ACAD/NP/M.E./Mech.,Chem.Engg./Syll./31/2013

It is hereby informed to all concerned that, on the recommendation of the Dean, Faculty of Engineering and Technology, the **Academic Council at its meeting held on 29-06-2013 has accepted the "Revised Syllabus of M.E. Mechanical" and "New Syllabus of M.E. Chemical Engineering" under "C.G.P.A." as per Appendix-"A" & "B" respectively under the Faculty of Engineering and Technology".**

This is effective from the **Academic Year 2013-2014** and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO.ACAD/NP/ENGG./SYLLABUS/
2013/30292-300

Date:- 20-08-2013.

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Director,
Board of College and
University Development.

Copy forwarded with compliments to :-

1] The Principals, affiliated concerned Colleges,
Dr. Babasaheb Ambedkar Marathwada University.
2] The Director, University Network & Information Centre, UNIC, with **a request to upload the above syllabi on University Website [www.bamu.ac.in].**

Copy to :-

1] The Controller of Examinations,
2] The Superintendent, [Engineering Unit],
3] The Programmer [Computer Unit-1] Examinations,
4] The Programmer [Computer Unit-2] Examinations,
5] The Superintendent, [Eligibility Unit] ,
6] The Director, [E-Suvidha Kendra], in-front of Registrar's Quarter,
Dr. Babasaheb Ambedkar Marathwada University,
7] The Record Keeper,
Dr. Babasaheb Ambedkar Marathwada University.

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Dr. Babasaheb Ambedkar Marathwada University Aurangabad.

Faculty of Engineering & Technology

Rules and Regulations for M.E. & M.Tech. -2014

- **What is a credit system**

  A credit system is a systematic way of describing an educational program by attaching credits to its components. The definition of credits in higher education systems may be based on different parameters, such as student workload, learning outcomes and contact hours.

- **Advantages of the Credit System**
  - Represents a much-required shift in focus from teacher-centric to learner-centric education since the work load estimated is based on the investment of time in learning, not in teaching.
  - Helps to record course work and to document learner work load realistically since all activities are taken into account-not only the time learners spend in lectures or seminars but also the time they need for individual learning and the preparation of examinations etc.
  - Segments learning experience into calibrated units, which can be accumulated in order to gain and academic award.
  - Helps self-paced learning. Learners may undertake as many credits as they can cope with without having to repeat all the courses in a given semester if they fail in one or more courses. Alternatively, they can choose other courses and continue their studies.

- **What is Grading?**

  The word Grade derived from the Latin word gradus, meaning, step. Grading, in the educational context is a method of reporting the result of a learner's performance subsequent to his evaluation. It involves a set of alphabets which are clearly defined and designated and uniformly understood by all the stake holders. A properly introduced grading system not only provides for a comparison of the learner's performance but it

also indicate the quality of performance with respect to the amount of efforts put in and the amount of knowledge acquired at the end of the courses by the learners.

- **CURRICULUM:**

1.1 Curriculum:

Every program with specialization has a prescribed course structure which in general terms is known as Curriculum. It prescribes course to be studied in each semester; the relevant information containing course structure along with detail syllabus for each course of each program is updated periodically and is uploaded on the website.

1.2 Semesters:

The Faculty of Engineering & Technology implements a credit based curriculum and grade based evolution system for P.G. program is of four semesters. The academic courses are delivered in the first two semesters. Dissertation work is carried out by a student in the third and fourth semester. The first semester begins in the last week of July ends by the last week of November while the second semester begins in the first week of January and ends by the second week of May. Total duration for each semester is generally of 20 weeks including the period of examination, evaluation and grade declaration.

1.3 Course Credit:

Education is organized around the semester-based credit system of study. The prominent features of the credit system are a process of continuous evaluation of a student's performance/progress and flexibility to allow a student to progress at an optimum pace suited to his/her ability or convenience, subject to fulfilling minimum requirements for continuation.

A student's performance/progress is measured by the number of credits that he/she has earned, i.e. completed satisfactorily. Based on the course credits and grades obtained by the student, grade point average is calculated. A minimum grade point average is required to be maintained for satisfactory progress and continuation in the program. Also a minimum number of earned credits and a minimum grade point average should be acquired in order to qualify for the degree. All programmes are defined by the total credit requirement and a pattern of credit distribution over courses of different categories.

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1.4 Course credits assignment

Each courses, except a few special courses, has a certain number of credits assigned to it depending upon its lecture, tutorial and laboratory contact hours in a week. This weightage is also indicative of the academic expectation that includes in-class contact and self-study outside of class hours.

Lectures and Tutorials: One lecture or tutorial hour per week per semester is assigned one credit.

Seminar/Contact Hours per week per semester is assigned one credit

Practical/Laboratory: One laboratory hour per week per semester is assigned half credit.

Example: Course: XYZ Engg: 3 credits (3-1-2)

The credits indicated for this course are computed as follows:

3 hours/week lectures = 3 credits

1 hours/week tutorial = 1 credit

2 hours/week practical = 2 x 0.5 = 1 credit

2 hours/week seminar = 2 x 0.5 = 1 credit

Dissertation seminar/Contact Hours = 1 x 1= 1 credit

(3-1-2) 3 credit course = (**3** h Lectures + **1** h Tutorial + **2** h Practical/Dissertation seminar) per week i.e. 6 Contact hours per week

1.5 Earning Credits

At the end of every course, a letter grade is awarded in each course for which a student had registered. On obtaining a pass grade, the student accumulates the course credits as earned credits. A student's performance is measured by the number of credits that he/she has earned and by the weighted grade point average.

The credit system enables continuous evaluation of a student's performance, and allows the students to progress at an optimum pace suited to individual ability and convenience, subject to fulfilling minimum requirement for continuation.

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1.6 Evaluation System

1. Semester Grade Point Average (SGPA) =

   SUM (course credits in passed courses X earned grade points)

   SUM (Course credits in registered courses)

2. Cumulative Grade Point Average (CGPA) =

   SUM (course credits in passed courses X earned grade points) of all Semester

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   SUM (Course credits in registered courses) of all Semester

3. At the end of M.E & M. Tech Program, student will be placed in any one of the divisions as detailed below.(According to AICTE Handbooks 2013-2014)

   Ist Division with distinction : CGPA $\geq$ 8.25 and above

   Ist Division : CGPA $\geq$ 6.75 and < 8.25

   IInd Division : CGPA $\geq$ 6.75 and < 6.25

As per AICTE Handbook (2013-14), new gradation suggested as follows,

Table 1

Grade Point	Equivalent Range
6.25	55%
6.75	60%
7.25	65%
7.75	70%
8.25	75%

Conversion of CGPA to percentage marks for CGPA $\geq$ 5.0 can be obtained using equations.

Percentage marks = (CGPA X10) – 7.5

An example of these calculations is given below:

Typically one example for academic performance calculations of semester –I

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Table 2

Course No. (1)	Course Credit (2)	Grade Awards (3)	Earned Credit (4)	Grade Points (5)	Points Secured (6)=(4) x (5)
Subject 1	4	B	4	6	24
Subject 2	4	C	4	5	20
Subject 3	4	O	4	10	40
Subject 4	4	A+	4	8	32
Subject 5	4	C	4	5	20
Lab-1	2	A+	2	9	18
Lab-2	1	A+	1	9	9
Seminar-I	1	A+	1	9	9
Total	24		24	61	172

1. Semester Grade Point Average (SGPA) = $\frac{(172)}{(24)} = 7.16$

2. Cumulative Grade Point Average (CGPA) =
   Cumulative points earned in all passed courses = 172 (past semester) + 172 (this sem.) = 344

   Cumulative earned credits = 24 (past semesters) +24 (this sem) = 48

   $\frac{\sum (172 + 172)}{\sum (24 + 24)} = 7.16$

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➢ **System Evaluation Table**

Table 3

Grade	Grade Points	Marks Obtained (%)	Description Performance
		Regular Semester	
O	10	91-100	Outstanding
A++	09	86-90	Excellent
A+	08	76-85	Very Good
A	07	66-75	Good
B	06	56-65	Fair
C	05	46-55	Average
D	04	40-45	Poor
F	00	Below 40	Fail
EE			Incomplete
WW			Withdrawal
XX	--	--	Detained
ABSENT	--	--	Absent
PP	--	--	Passed (Audit Course)
NP	--	--	Not Passed (Audit Course)

➢ **Grade Awards:**

i) A ten point rating scale shall be used for the evaluation of the performance of the student to provide letter grade for each course and overall grade for the Master's Programme. Grade points are based on the total number of marks obtained by him/her in all the heads of examination of the course. These grade points and their equivalent range of marks are shown separately in Table-4.

Table 4: Ten point grades and grade description

Sr.No.	Equivalent Percentage	Grade Points	Grade	Grade Description
1	90.00 – 100	10	O	Outstanding
2	80.00 – 89.99	9	A++	Excellent
3	70.00 – 79.99	8	A+	Exceptional
4	60.00 – 69.99	7	A	Very Good
5	55.00 – 59.99	6	B+	Good
6	50.00 – 54.99	55	B	Fair
7	45.00 – 49.99	5	C+	Average
8	40.01 – 44.99	4.5	C	Below Average
9	40	4.00	D	Pass
10	<40	0.00	F	Fail

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ii) Non appearance in any examination/assessment shall be treated as the student have secured zero mark in that subject examination/assessment.

iii) Minimum D grade (4.00 grade points) shall be the limit to clear/pass the course/subject. A student with F grade will be considered as 'failed' in the concerned course and he/she has to clear the course by reappearing in the next successive semester examinations.

iv) Every student shall be awarded Grade points out of maximum 10 points in each subject (based on 10 Point Scale). Based on the Grade points obtained in each subject, Semester Grade Point Average (SGPA) and then Cumulative Grade Point Average (CGPA) shall be computed. Results will be announced at the end of each semester and cumulative Grade card with CGPA will be given on completion of the course.

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Proposed Coding System of M.E/M.Tech Subjects

Six Digit Code for a subject (PG Course)

	Digits →	1 2 3	4	5 6
Sr. No.	**Branch ↓**	**Branch code**	**Year**	**Subject**
1	Electronics	MEX	PG I year – 6	**Semester –I/III**
2	Electronics & Communication	MEC	PG II Year - 7	1-20 Theory
3	Electronics & Telecom.	MET		21-30 Practical
4	Digital Communication	MDC		31 Dissertation-I
5	Embedded System	MES		41-49 Electives
6	Structure Engineering	MSE		**Semester –II/IV**
7	Environmental Engineering	MEV		51-70 Theory
8	Water Resource Engineering	MWR		71-80 Practical
9	Computer Engineering	MCE		81 Dissertation-II
10	Computer Network	MCN		91-99 Electives
11	Software Engineering	MSW		
12	Mechanical Engineering	MME		
13	Thermal Engineering	MTE		
14	CAD/CAM	MCC		
15	Manufacturing	MMF		
16	Heat Power	MHP		
17	Design Engineering	MDE		
18	Machine Design	MMD		
19	Automation	MEA		
20	Chemical Engineering	MCH		
21	Computer & IT	MCI		
22	Production Process	MMP		
23	M.Tech Computer Science	MTC		
24	M.Tech Food Processing	MTF		
25	M.Tech Mechanical	MTM		

Note: - Kindly, Allot Same Code for same Electives/ subjects for different branches to avoid repetitions of Question papers/settings/assessments.

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DEGREE OF MASTER OF ENGINEERING/TECHNOLOGY
(Course with effective from academic year: 2013-2014)

I	1	The examination for the Degree of Master of Engineering & Technology will be held in four semesters, M.E./M.Tech. Semester-I, M.E./M.Tech. Semester-II, M.E. ./M.Tech Semester-III, and M.E./M.Tech. Semester-IV in case of full time course. And for part time additional semester V & VI
II	**Rules & Eligibility**	
	1	Rule for admission to P.G. Degree course in Engineering and Technology as per rules and regulation of AICTE/DTE & Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.
III	**Evaluation method**	
	1	Each theory course will be of 100 marks and be divided in to internal examination of 20 marks and semester examination of 80 marks (20+80=100 marks). Each practical course will be of 50/100 marks
	2	There shall be minimum two class tests within a semester. First based on 30% syllabus taught and second based on 30% syllabus taught. The setting of question paper and assessment will be done by the concerned teacher who has taught the syllabus. Average marks obtained out of two examinations will be considered for the preparation of final sectional marks/ grade.
	3	The Question papers in theory subjects shall be set by the Examiners appointed for the purpose by the University on the recommendations of the Board of studies of the concerned PG Course.
	4	The assessment of the Practical for any subject will be done by recognized post-graduate teacher appointed by University.
	5	To pass the examination a candidate must obtain a minimum CGPA of 6.25 (CGPA to the scale of 10).
	6	Candidate who secures CGPA $\geq$ 6.25 and CGPA < 6.75 declared to have passed examination in second class.
	7	Candidate who secures CGPA $\geq$ 6.75 and CGPA < 8.25 declared to have passed examination in first class.
	8	Candidate who secures CGPA $\geq$ 8.25 declared to have passed examination in

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		first class with distinction.
IV	1	In case candidates fails to get less than D grade in one or more heads of passing examination, he will be allowed at his option, to reappear for only those heads of passing in which he has failed or got less than D grade at subsequent examinations.
	2	The grades obtained by the candidate in any head of passing at the examination will be carried forward unless the candidates reappear for the head of passing in accordance with ref. IV (1)
	3	In case the candidate passes in all heads of passing under M.E./M.Tech. Semester-I, M.E./M.Tech. Semester-II examination and obtained a minimum CGPA of 6.25 in M.E./M.Tech Semester-I, M.E./M.Tech Semester-II taken together as required under ref. II(2) above, he will not be allowed to reappear for any head of passing under M.E. Semester-I, M.E. Semester-II in accordance with ref. III(5)
	4	A candidate will not be allowed to appear for M.E. ./M.Tech Semester-III examination unless he passes in all heads of passing under M.E. ./M.Tech Semester-I, M.E./M.Tech Semester-II examination and obtains a minimum CGPA of 6.25.
	5	Whenever a candidate reappears for M.E. ./M.Tech Semester-III and M.E./M.Tech. Semester-IV examinations he will have to resubmit the dissertation with suitable modification and must also reappear for oral examination on it.
	6	A candidate registered for M.E./M.Tech Examination must clear his examination within five years from the date of registration.
V	**Attendance Requirement**	
	1	Each semester of the course shall be treated as a separate unit for calculation of the attendance
	2	A candidate shall be considered to have satisfied the attendance requirement if he/she has attended not less 75% of the class in each subject of all the semesters (Theory, Laboratory, Semester Practical training and Dissertation work) actually conducted up to the end of the semester.
	3	A Candidate, who does not satisfy the attendance required, mentioned as above, shall not be eligible to appear for the Examination of that semester and

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		shall be required to repeat that semester along with regular students later.
	4	The Principal of the concerned College shall display regularly, the list of such candidates who fall short of attendance, on the Notice Boards.
	5	The list of the candidates falling short of attendance shall be sent to the University at least one week prior to the commencement of theory/practical examination, whichever is earlier.
VI	.	The following are the syllabi in the various subjects of the examination for the Degree of Master of Engineering/Technology.

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD.

Revised Syllabus of

M.E.

(MECHANICAL)

[Effective from the Academic Year 2013-14 & onwards]

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

Proposed Teaching/Examination Scheme for the degree of Master of Engineering (M.E.-Mechanical)

w. e. f. Academic Year 2013-2014

Semester – I

Course Code	Name of Subject	Teaching Scheme Contact hrs per week				Examination Scheme Marks					Duration of Theory Exam	Credit
		L	T	P	Total Hrs	Theory	Class Test	Term work	Viva-voce	Total		
MME 601	Advanced Optimization Techniques	03	01	-	04	80	20	-	-	100	3 Hrs	4
MME 602	Modern Engineering Materials	03	01	-	04	80	20	-	-	100	3 Hrs	4
MME 603	Advanced I.C. Engines	03	01	-	04	80	20	-	-	100	3 Hrs	4
MME 641	Elective-I	03	01	-	04	80	20	-	-	100	3 Hrs	4
MME 642	Elective-II	03	01	-	04	80	20	-	-	100	3 Hrs	4
MME 621	Lab-I	-	-	04	04	-	-	50	-	50	-	2
MME 622	Lab – II	-	-	02	02	-	-	-	50	50	-	1
MME 623	Seminar – I	-	-	02	02	-	-	-	50	50	-	1
	Total	**15**	**05**	**08**	**28**	**400**	**100**	**50**	**100**	**650**	**15**	**24**

*Elective Subjects:

Elective	Group A : Design	Group B : Production	Group C : Heat and Power
Elective-I (MME 641 A-C)	Computational Modeling and Simulation	Maintenance & Reliability Engineering	Advanced Thermodynamics
Elective-II (MME 642 A-C)	Machine Stress Analysis	Productivity Management	Advanced Heat Transfer

***Note: Candidates are required to opt the elective subjects (Elective I, II, III & IV) from the same group as mentioned above.**

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Proposed Teaching/Examination Scheme for the degree of Master of Engineering (M.E.-Mechanical)

w. e. f. Academic Year 2013-2014

Semester – II

Course Code	Name of Subject	Teaching Scheme Contact hrs per week				Examination Scheme Marks					Duration of Theory exam	Credit
		L	T	P	Total Hrs	Theory	Class Test	Term Work	Viva-voce	Total		
MME 651	Advanced Machine Design	03	01	-	04	80	20	-	-	100	3 Hrs	4
MME 652	Advanced Manufacturing Techniques	03	01	-	04	80	20	-	-	100	3 Hrs	4
MME 653	Engineering Experimental Techniques	03	01	-	04	80	20	-	-	100	3 Hrs	4
MME 691	Elective-III	03	01	-	04	80	20	-	-	100	3 Hrs	4
MME 692	Elective-IV	03	01	-	04	80	20	-	-	100	3 Hrs	4
MME 671	Lab-III	-	-	04	04	-	-	50	-	50	-	2
MME 672	Lab-IV	-	-	02	02	-	-	-	50	50	-	1
MME 673	Seminar – II	-	-	02	02	-	-	-	50	50	-	1
	Total	**15**	**05**	**08**	**28**	**400**	**100**	**50**	**100**	**650**	**15**	**24**

*Elective Subjects:

Elective	Group A : Design	Group B : Production	Group C : Heat and Power
Elective-III (MME 691)	Finite Elements Methods (FEM)	Computer Aided Design (CAD)	Computational Fluid Dynamics (CFD)
Elective-IV (MME 692)	Mechanical Vibrations	Computer Integrated Manufacturing (CIM)	Refrigeration and Cryogenic Systems

***Note: Candidates are required to opt the elective subjects (Elective I, II, III & IV) from the same group as mentioned above.**

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Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

Proposed Teaching/Examination Scheme for the degree of Master of Mechanical (Mechanical)

w. e. f. Academic Year 2013-2014

Semester – III

Course code	Name of the Subject	Teaching Scheme Hrs per week			Examination scheme Marks				Credit
		L	CH	Total hrs	Theory	Term work	Viva voce	Total	
MME 731	Dissertation Part – I	-	12	12	-	50	50	100	12
	Total	-	12	12	-	50	50	**100**	**12**

Semester – IV

Course code	Name of the Subject	Teaching Scheme Hrs per week			Examination scheme Marks				Credit
		L	CH	Total hrs	Theory	Term work	Viva voce	Total	
MME 781	Dissertation Part- II	-	20	20	-	100	200	300	20
	Total	-	**20**	**20**	-	**100**	**200**	**300**	**20**
	Grand Total							**1700**	**80**

L: Lecture hours per week T: Tutorial Hours per week P: Practical hours per week CH: Contact Hours

Total Credits = SEM I + SEM II + SEM III + SEM IV
= 24 + 24 + 12 + 20
= 80

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Semester-I

(MME 601) Advanced Optimization Techniques

Teaching Scheme:
Lectures: 03 h/week
Tutorials: 01 h/week
Credit: 4

Examination Scheme:
Theory Paper: 80 Marks (3 h)
Class Test: 20 Marks (1h)

Units Contents

1 Introduction: Optimal problem formulation, engineering optimization problems, optimization algorithms.
Single Variable Optimization Algorithms: Optimality criteria, bracketing methods, region elimination methods, point estimation methods, gradient base, root finding using optimization techniques. **8**

2 Multivariable Optimization Algorithms: Optimality criteria, unidirectional search, direct search methods, gradient based methods, computer programs on above methods. **8**

3 Constrained Optimization Algorithms: Kuhn-Tucker conditions, transformation methods, sensitivity analysis, direct search for constrained minimization, linearised search techniques, feasible direction method, generalized reduced gradient method, gradient projection method, computer programs on above methods. **8**

4 Special Optimization Algorithms: Integer programming, Geometric programming, Genetic Algorithms, Simulated annealing, global optimization, Computer programs on above methods. **8**

5 Optimization in Operations Research: Linear programming problem, simplex method, artificial variable techniques, dual phase method, sensitivity analysis **8**

Reference Books

1. Deb Kalyanmoy, "Optimization in Engineering Design", PHI, New Delhi.
2. Rao S.S. "Engineering Optimization", John Wiley, New Delhi.
3. Deb Kalyanmoy, "Multi-objective Algorithms using Evolutionary Algorithms", John Wiley, New Delhi.
4. Paplambros P.Y. and Wilde D.J., "Principles of Optimum Design: Modeling and Computation", Cambridge
University Press, UK
5. Chandrupatla, "Optimization in Design", PHI, New Delhi.

(MME 602) Modern Engineering materials

Teaching Scheme:
Lectures: 03 h/week
Tutorials: 01 h/week
Credit: 4

Examination Scheme:
Theory Paper: 80 Marks (3 h)
Class Test: 20 Marks (1h)

Units Contents

1) Ferrous materials: Mechanical properties, heat treatments and application; stainless steel and heat resisting steels, precipitation hardenable steel, valve steels, high strength low alloy steel (HSLA), micro alloyed steels, ball bearing steel, Tool steel, high nitrogen steel, alloy cast iron. **8**

2) Nonferrous Materials: Mechanical Properties, heat treatment and applications, copper alloys (brasses & bronzes), Al- alloys (Al-Mg-Si,Al-Cu,Al-Si), designation system in Al-alloys. **8**

3) Composites: classifications, properties, application of composites, polymer matrix materials, metal matrix materials, ceramic matrix materials, carbon materials, glass materials, fiber reinforcements, types of fibers, whiskers, laminar composites, filled composites, particulates reinforced composites. **8**

4) Design composites materials: hybrid composites, angle plied composites, mechanism of composite, calculation of properties, unidirectional fiber composites, critical volume fraction, discontinuous fiber composites, rule of mixtures equation, critical angle, Analysis of an orthographic lamina, strength of orthographic lamina, analysis laminated composites, stress, strain variations in laminates. **8**

5) Organic materials: classification, properties, application of polymers, plastic and elastomers. **3**

6) Ceramic: classification, properties, structure of refractories, abrasive materials, electronics ceramics, cement and concrete. **5**

Assignments

It shall consists of the record of at least five assignments based on the above syllabus

Reference Books

1. Jastrezebski Z.D., "The nature and properties of engineering materials"
2. Avner S.H., " Introduction to physical metallurgy"
3. Sharma S.C., "Composite materials"
4. DeGarmo E.P., Black J.T., kosher R.A., "Materials and processes in manufacturing"
5. Rajput R.K., " Materials Science and Engineering"
6. Chawla K.K., "Composite Materials"
7. Nayar Alok, "The Metals Data Book"
8. Fried Joel R., Polymer Science and Technology"
9. Agrawal B.D., Broutman L.J., " Analysis and performance of fiber composites", john Wiley, New York
10. ASM Handbook- volume 10 Material characterization.

(MME 603) Advanced I.C. Engines

Teaching Scheme:
Lectures: 03 h/week
Tutorials: 01 h/week
Credit: 4

Examination Scheme:
Theory Paper: 80 Marks (3 h)
Class Test: 20 Marks (1h)

Unit Contents

1) Spark Ignition Engines: Mixture requirements, Fuel Induction systems, Stages ofcombustion, Normal and abnormal combustion, factors affecting knock, Combustion chambers. **8**

2) Compression Ignition Engines: Stages of combustion in C.I. Engine, Direct and indirect Injection systems, Combustion chambers, Fuel spray behavior, spray structure, spray Penetration and evaporation, air motion, Turbo charging and Supercharging. **8**

3) Scavenging & super charging: Scavenging process & efficiencies in 2-stroke engines, supercharging power required & effects on engine performance, different types of turbo-charges. **8**

4) Engine Emissions & Control: Air pollution due to IC engines, norms, Emissions, HC, CO, NOx, particulates, other emissions, emission control methods, Exhaust gas recirculation, modern methods, crankcase blowby. **8**

5) Modeling & Simulation Technique: Combustion models, Basic concepts of engine siulation techniques ,**Recent trends in Engine Technology & alternative fuels** **8**

Reference Books:

1. E.F. Obert, "Internal Combustion Engines and Air Pollution", Intext Educational Publishers, 1973
2. John B Heywood, "Internal Combustion Engine Fundamentals", McGraw Hill, 1989
3. M.L. Mathur and R.P.Sharma, "A course in internal Combustion Engines", Dhanapat Rai Publications, New Delhi
4. V. Ganesan, "Int. Combustion Engines", II Edition, TMH, 2002.
5. Ganesan V., "Computer simulations of spark ignition process", University press, Hyderabad 1993.
6. Ganesan V., "Computer simulations of compression ignition engines", Orient Long man 2000.
7. Plint Michael and Martyr Anthony "Engine Testing Theory and Practice", Second Edition, SAE International, (1999)
8. Ramos J.I., " I.C. Engine Modeling", Hemisphere Publishing Corporation (T&F Group) NY

(MME 641-A) Computational Modeling and Simulations (CMS)

Teaching Scheme:
Lectures: 03 h/week
Tutorials: 01 h/week
Credit: 4

Examination Scheme:
Theory Paper: 80 Marks (3 h)
Class Test: 20 Marks (1h)

Units Contents

1) **Introduction to simulation**: System and system environment, Components of the system, type of systems, type of models, steps in simulation, study advantages and disadvantages of simulations, concept of discrete simulation, time advance mechanisms, components and organization of a discrete -event simulation model. 8
2) **Statistical models in simulation**: Useful statistical models, discrete distributions, continuous distribution, Poisson process, empirical distribution. 4
3) **Random number generation**: Properties random numbers, generation pseudo random numbers, techniques for random numbers generation, tests for random numbers. 8
4) **Random variate generation:** Inverse transforms techniques, convolution method, acceptance rejection techniques. 4
5) **Input Modeling:** data collection, indentifying the distribution of data, parameter estimation, goodness of fit tests, selection of input model without data, multivariate and time series input model. 4
6) **Verification and validation of simulation model:** length of simulation runs, validation. 3
7) **Output analysis for a single model:** types of simulation with respect to output analysis, stochastic nature of output data, measure of performance and their estimation, output analysis of terminating simulation, output analysis of steady state simulation, case study in simulation, orientation of simulation software such as GPSS. 9

Assignments

It shall consists of record of at least five assignments based on above syllabus

Reference Books

1. Law A.W., Kelton D., "Simulation Modeling and analysis", Tata McGraw Hill, 2003
2. Gordon Geoffrey, "System Simulation", 2nd Ed.PHI,New Delhi,1990
3. Deo Nassingh, "System Simulation with digital computers", PHI, New Delhi,1989
4. Zeigler B., Prachofer H., Kim T.G., "Theory ofModeling and Simulation", Academic Press
5. Body Donald W., "System analysis and Modeling", Academic press Harcourt India
6. Banks Jerry, Carson John, Nelson Barry,Nicole David, "Discrete Event Simulation"
7. Kelton W.D., Sadowski R., Sadowski D., "Simulation with Arena" , McGraw Hill Publications

(MME 642-A) Machine Stress Analysis (MSA)

Teaching Scheme:
Lectures: 03 h/week
Tutorials: 01 h/week
Credit: 4

Examination Scheme:
Theory Paper: 80 Marks (3 h)
Class Test: 20 Marks (1h)

Unit Contents

1) Theory of Elasticity: Plane stresses and plane strain: plane stress, plane strain, and stress and strain at a point, differential equations of equilibrium, boundary conditions, compatibility equations, Airy's stress function. **Two-dimensional problems in rectangular coordinates:** Solutions by polynomials, end effects, Saint Venant's principle. Two-dimensional problems in polar coordinates: General equations in polar coordinates, stress distribution symmetrical about axis, strain components in polar coordinates. **8**

2) Applications of Energy Methods: First and second theorms, Castigliano's theorems, applications for analysis of loaded members to determine deflections and reactions at supports. **Theory of Torsion:** Torsion of prismatic bars of non-circular cross sections, Thin walled hollow and rectangular cross sections, Saint Venant's theory, Prandtle's membrane analogy, Kelvin's fluid flow analogy, warping of the cross sections. **8**

3) Experimental Stress Analysis: Stress analysis by – mechanical, optical and electrical strain gauges,strain rosette, whole field methods, Moire fringe method, brittle coatings for strain indication. **8**

4) Shear Center and Unsymmetrical Bending: Shear center for beams of different cross sections, bending and deflections of beams subjected to unsymmetrical bending. **8**

5) Contact Stresses: Hertz's contact stresses, expression for principle stresses, deflection of bodies in point contact, stress in bodies in point and line contacts. **8**

Reference Books:

1. Timoshenko and Young, "Theory of Elasticity", TMH Publications.
2. Seely and Smith, " Advanced Mechanics of Materials", John Wiley, New York
3. Den Hartog J. P., "Advanced Strength of Materials", McGraw Hill Publications.
4. Nash W., "Strength of Materials", Schaum's outline series, McGraw Hill

(MME 641-B) Maintenance and Reliability Engineering (MRE)

Teaching Scheme:
Lectures: 03 h/week
Tutorials: 01 h/week
Credit: 4

Examination Scheme:
Theory Paper: 80 Marks (3 h)
Class Test: 20 Marks (1h)

Unit Contents

1) Introduction: Reliability concepts and patterns of failure, reliability Management, reliability, for system effectiveness. **Reliability and hazard rates:** Failure data, reliability function, failure rate and hazard rate, common distributions in failure mechanisms – experimental, Welbull, gamma, Normal, log normal, extreme value, model selection for components failure, failure analysis. **10**

2) Reliability prediction and analysis: reliability prediction based on exponential distribution, system reliability analysis – block diagram method, fault tree and success tree methods, event tree method, failure model, failure mechanism. **6**

3) Reliability design: Design for reliability, design process, assessment methodology, reliability allocation, reliability improvement, selection of components to improve system reliability. **6**

4) Maintenance in context: maintenance and profitability, terro-technology, application of terro-technology. **Principles:** the structure of plant, reason for nature of maintenance work, the production maintenance system a dynamic model. **8**

5) Establishing a maintenance plan-preliminary consideration: items, classification of items, maintenance procedure, guidelines for machine procedures to items. **Maintenance planning and control:** Basic requirements, Management information, labour costs, computer based Management information system, work planning and work control, basic rules for success. **10**

Reference Books:

1. L. S. Srinath, "Concepts in Reliability in Engineering", Affiliated East West Press.
2. K. C. Kapur and L. R. Lumbersome, "Reliability in Engineering Design", John Willey and sons.
3. C. Singh and B. S. Dhillon, "Engineering Reliability-New Techniques and Applications", John Wiley and sons.
4. F. J. Henley, "Designing for reliability and safety control", Hiromitsu
5. Kumamoto, "System reliability", PHI Pub.
6. B Bhadury and S.K. Basu, "Terotechnology: Reliability Engineering and Maintenance Management", Asian Books, New Delhi 2002.
7. Kelly, "Maintenance Planning and Control", A Buttersworth & Co.
8. Krishnan G., "Maintenance and Spare parts Management", Prentice Hall 1991
9. A.K.Gupta, "Reliability Maintenance and Safety Engineering", Laxmi Pub.

(MME 642-B) Productivity Management (PM)

Teaching Scheme:
Lectures: 03 h/week
Tutorials: 01 h/week
Credit: 4

Examination Scheme:
Theory Paper: 80 Marks (3 h)
Class Test: 20 Marks (1h)

Unit Contents

1) Introduction: Productivity concepts – Macro and Micro factors of productivity, productivity benefit model, productivity cycles. **Productivity concepts and definitions:** Productivity, Importance, role of productivity, Productivity improvement factors-internal factors of enterprises productivity (hard and soft factors), external factors affecting productivity. **6**

2) Productivity Models: Productivity Measurement at International, National and organization level, total productivity models. Productivity Management in manufacturing and service sector. Productivity evaluation models, productivity improvement model and techniques. **Productivity analysis:** An approach to productivity appraisal, total productivity, labour productivity, **Productivity analysis in the enterprises:** The Kurosawa structural approach, Lawlor's approach, Gold's approach, quick productivity appraisal approach (QPA), inter-ferm comparison (IFC), some problems on productivity analysis. **10**

3) Improving Productivity: Managing organization effectiveness: general consideration, productivity improving strategy, productivity improvement programmes (PIP), organizational approach to productivity improvement programmes. **Productivity Improvement Techniques:** Industrial engineering techniques and economic analysis, work study, work simplification, Pareto analysis, JIT, management through analysis, cost benefit analysis, zero base budgeting. **8**

4) Method Study: Method and Method Study – Need for Method Study – Procedure of Method Study – Principles of Motion Economy Behavior Techniques- brainstorming, force field analysis **Business Process Reengineering:** Concept of BPR, process of BPR, prerequisites for effective BPR implementation, application of BPR in productivity improvement. **8**

5) Work Measurement: Techniques of Work Measurement including Estimating, Stopwatch Time Study, Predetermined Time Standards, Synthetic Estimates of Work Times, and Activity Sampling. Computation of Standard Time – Elements – Types of Elements – Performance Rating – Allowances – Need for Allowances – Types of Allowances, MOST **Effective Human Resource Management:** Management of People, The role of Management, Manpower motivation, productivity training **TPM:** Meaning and objectives of TPM; Methodology of TPM, gains of TPM. **8**

Reference Books:

1. Sumanth, D.J., "Productivity engineering and management", Tata McGraw-Hill, New Delhi 1990.
2. Edsomwan, J.A., "Organisational transformation and process re-engineering", British Library Cataloging in Pub. data 1996.
3. Joseph Prokopenko, "Productivity Management-A practical Handbook", ILO Geneva
4. Prem Vrat, G.D.Sardana, B.S.Sahay, "Productivity Management-A system approach", Narosa Publication.

5. John G., Jr. Belcher, "Productivity Plus: How Today's Best Run Companies Are Gaining the Competitive Edge", Butterworth-Heinemann
6. H. James Harrington, "Business Process Improvement: The Breakthrough Strategy for Total Quality,
Productivity and Competitiveness", McGraw-Hill
7. Carl G. Thor, "Handbook for Productivity Measurement and Improvement", Productivity Press
8. Rastogi, P.N., "Re-engineering and re-inventing the enterprise", Wheeler publications, New Delhi 1995.
9. Work Study-ILO

(MME 641-C) Advanced Thermodynamics

Teaching Scheme:
Lectures: 03 h/week
Tutorials: 01 h/week
Credit: 4

Examination Scheme:
Theory Paper: 80 Marks (3 h)
Class Test: 20 Marks (1h)

Unit Contents

1) Equation of State: State postulate for Simple System and equation of state, Ideal gas equation, Deviation from ideal gas, Equation of state for real gases, generalized Compressibility chart, Law of corresponding states **Properties of Pure Substances:** Phase change process of pure substances, PVT surface, P-v &PT diagrams, Use of steam tables and charts in common use. **8**

2) Laws of thermodynamics, 2nd law Analysis for Engg. Systems, Entropy flow & entropy generation, Increase of entropy principle, entropy change of pure sub, T-ds relations, entropy generation, thermo electricity, Onsager equation. Exergy analysis of thermal systems, decrease of Exergy principle and Exergy destruction. **8**

3) Thermodynamic Property Relations: Partial Differentials, Maxwell relations, Clapeyron equation, general relations for du, dh, ds, and Cv and Cp, Joule Thomson Coefficient, Δh, Δu, Δs of real gases. **6**

4) Chemical Thermodynamics Chemical reaction - Fuels and combustion, Enthalpy of formation and enthalpy of combustion, First law analysis of reacting systems, adiabatic flame temperature Chemical and Phase equilibrium - Criterion for chemical equilibrium, equilibrium constant for ideal gas mixtures, some remarks about Kp of Ideal-gas mixtures, fugacity and activity, Simultaneous relations, Variation of Kp with Temperature, Phase equilibrium, Gibb's phase rule, Third law of thermodynamics, Nerst heat theorem and heat death of universe. **8**

5) Gas Mixtures – Mass & mole fractions, Dalton's law of partial pressure, Amagat's law, Kay's rule. **Statistical Thermodynamics-** Fundamentals, equilibrium distribution, Significance of Lagrangian multipliers, Partition function for Canonical Ensemble, partition function for an ideal monatomic gas, equipartition of energy, Bose Einstein statistics, Fermi- Dirac statistics. **10**

Reference Books:

1. Cengel, "Thermodynamics", TMH
2. Nag P.K., "Basic & Applied Thermodynamics", TMH, New Delhi.
3. Kalyan Annamalai, Ishwar K. Puri, "Advanced Thermodynamics Engineering", CCRC PRESS
4. Holman, "Thermodynamics", 4th edition, McGraw Hill
5. Rao, Y.V.C., "Postulational and Stastistical thermodynamics", Allied Pub. Inc.
6. Jones and Hawkings, "engineering Thermodynamics", John Wiley & Sons, Inc. USA
7. Faires V. M. and Simmag, "Thermodynamics", McMillan Pub. Co. Inc. USA
8. Stephen Turns, "Thermodynamics- Concepts and Applications", Cambridge University Press

(MME 642-C) Advanced Heat Transfer

Teaching Scheme:
Lectures: 03 h/week
Tutorials: 01 h/week
Credit: 4

Examination Scheme:
Theory Paper: 80 Marks (3 h)
Class Test: 20 Marks (1h)

Unit Contents

1) Brief introduction to different modes of heat transfer and the basic laws of heat conduction, convection and radiation. Heat transfer applications. One-dimensional steady state heat conduction. Extended surfaces. Design and analysis of fins. Fins of constant and variable cross section. Two dimensional steady state heat conduction in semi-infinite and finite flat plates. Graphical method and relaxation method for solving 2D heat conduction problems. Conduction shape factor. **10**

2) Transient heat conduction. Lumped heat capacity systems. Response of thermocouple. Use of Heisler charts for solving one dimensional unsteady state heat transfer problems in infinite plates, cylinders and spheres. Periodic heat flow. **6**

3) Convective heat transfer. Concept of velocity and thermal boundary layers. Laminar and Turbulent flow. Differential convection equations. Non dimensional convection equations. Analogy between momentum and heat transfer for laminar and turbulent flow. External forced convection, Parallel flow over a flat plate, Flow over cylinders, spheres and tube banks. Mixed boundary layer considerations Internal forced convection, Thermal analysis and convection correlations for laminar and turbulent flow in circular and non circular tubes, Constant heat flux and constant wall temperature conditions. Heat transfer enhancement Free Convection, Empirical correlations for external free convection flows for various geometries and orientations, free convection within parallel plate channels. Empirical correlations for enclosures Combined free and forced convection.**6**

4) Boiling heat transfer. The pool boiling curve. Modes of pool boiling and correlations. Transition boiling and system influences. Forced convection boiling in tubes. Two phase flow in horizontal tubes. Limiting heat fluxes in flow boiling. Condensation heat transfer phenomenon. Condensation number, laminar film condensation on a vertical plate, Correlations for condensation inside and outside a vertical tube, on inclined plates, on outer surface of horizontal tube, on horizontal tube bank, turbulent film condensation, Drop wise condensation. Design considerations of Heat pipe. **8**

5) Principles of thermal radiation. Greenhouse effect. Atmospheric and Solar radiation. Radiation exchange between black and non black surfaces. Direct method (Matrix method) and Network method for solving radiation heat transfer problems. Radiation shields. Radiation exchange with emitting and absorbing gases. Radiation effect on temperature measurement. Multimode heat transfer. **10**

Reference Books:

1. Yunus Cengel, "Heat Transfer: A Practical Approach", 3 (2007), Tata McGraw-Hill
2 Holman J.P., "Heat transfer", Tata McGraw Hill,
3 Hottel H.G.& Sarofim A.F., "Radiative Heat Transfer", McGraw Hill
4 Michael Modest, "Radiative Heat Transfer", McGraw Hill
5 Sukhatme S.P., "Heat transfer", University Press
6 Sarit K. Das, "Engineering Heat & Mass Transfer", Dhanpat Rai

(MME 621) Lab-I

Teaching Scheme:
Practical: 04 hrs/week
Credit: 2

Examination Scheme:
Term Work: 50 Marks

The Lab work consists of the assignments/ experiments related to,

- Material Characterization
- Study of Wear (Wear Analysis) for different materials.
- Study of modern materials and alloys

(MME 622) LAB – II

Teaching Scheme:
Practical: 02 hrs/week
Credit: 1

Examination Scheme:
Viva – voce: 50 Marks.

Lab II consists of:

The candidate will deliver an industrial case study in front of two examiners (one internal and Other appointed by the university)

(MME 623) SEMINAR – I

Teaching Scheme:
Tutorials/Practical: 02 h/week
Credit: 1

Examination Scheme:
Viva – voce: 50 Marks.

Seminar –I: It shall be based on the literature survey on any topic, which may lead to dissertation in that area. It will be submitted as a report.

The candidate will have to deliver a seminar presentation before the examiners, one of them will be guide and the other will be examiner appointed by the university.

Semester-II

(MME 651) Advanced Machine Design

Teaching Scheme:
Lectures: 03 h/week
Tutorials: 01 h/week
Credit: 4

Examination Scheme:
Theory Paper: 80 Marks (3 h)
Class Test: 20 Marks (1h)

Unit Contents

1) Fundamentals of Design Considerations: Principal planes and Principal stresses, tri-axial State of stresses, Mohr's circle for tri-axial state of stresses and strains, volumetric strains, Principal stresses computed from Principal strains, Principal strains due to perpendicular stresses & shear stresses. **8**

2) Mechanical Springs: Design of square or rectangular bar helical springs, Belleville springs, ring springs, torsion bar springs, theory of square or rectangular bars helical springs under axial loading, cone or flat disc spring theory. **8**

3) Cams: Basic curves, cam size determination, calculating cam profiles, advance curves, polydyne cams, dynamics of high speed cam systems, surface materials, stresses and accuracy, ramps. **8**

4) Fracture and Creep: Fracture Mechanics approach to design. Causes and interpretation of failures; Creep behavior; rupture theory; creep in high temperature low cycle fatigue; designing against creep. **8**

5) Computer Aided Machine Design: Philosophy of Computer Aided Machine Design, Interactive design software, Basic advantages of analysis Software, Design of machine components (springs, gears, temporary fasteners, permanent fasteners, belts and ropes) through interactive programming. **8**

Reference Books:

1. L S Srinath, "Advanced Solid Mechanics", Tata McGraw-Hill
2. V Ramamurti, "Computer Aided Mechanical Design and Analysis", (Third Edition), Tata McGraw-Hill
3. Wahl A.M., "Mechanical Springs"
4. Rothbart John, "Cams", Wily & sons
5. Sidebottom Borosi, "Advance Mechanics of materials", John Wily & sons Pub
6. Smith Seely, "Advanced Mechanics of materials", John Wily & sons Pub
7. Timoshenko , "Strength of Materials"
8. Kocanda, "Fatigue Failure of Metals", Sijthoff & Noordhoff International Publication
9. Behan & Crawford, "Mechanics of Engineering Materials", John Wily & sons Pub
10. Spotts M.F., "Mechanical Design Analysis", PHI Publications, New Delhi
11. R. C. Juvinall, "Fundamentals of Machine Component Design"

(MME 652) Advanced Manufacturing Techniques

Teaching Scheme:
Lectures: 03 h/week
Tutorials: 01 h/week
Credit: 4

Examination Scheme:
Theory Paper: 80 Marks (3 h)
Class Test: 20 Marks (1h)

Unit Contents

1)Advances in casting Process: Rapid casting development, design for casting, manufacturing health-checks, guidelines for improving the casting design, web based collaboration, rapid tooling development, rapid prototype patterns, rapid tooling methods, benchmarking of RP and T routes for casting application, casting process planning, process planning, selection of steps and process parameters, casting cost estimation, sheet moulding casting V process, Flask less moulding, evaporative casting, plaster mould casting, design for plaster mould casting, quality, accuracy, uniformity in casting and moulding. **10**

2)Manufacturing by machining: analysis of tool –chip interface-Geometry and models of tool wear, tool-life and tool-temperature, tool-chip interface friction, tool condition monitoring, importance and various techniques used, precision and surface finish operation, lapping, honinig, super finishing, polishing, buffing ,deburring, precission grinding. **9**

3)Chip less Metal removal processes: Non-traditional manufacturing processes, abrasive jet machining, water jet machining, Magneto abrasive finishing, wire EDM, Micro drilling by different processes like laser beam, ion beam, electro jet, electro stream drilling, non-traditional deburring processes. **7**

4)Plastic Manufacturing processes: compression molding, transfer molding, injection molding, extrusion cold molding, thermo forming, blow molding, Roto molding, structured form molding. **6**

5)Metallic coating: Importance, Principle application of-chemical vapor deposition, physical vapor deposition, thermal spray coating, electroplating, electroless coating. **8**

Reference Books

1. Benjamin W., Niebel A., " Modern manufacturing process engineering"., Tata- McGraw Hill publications.
2. Bendict G.F., Dekker, " Nontraditional manufacturing process" Marcel Inc. New York.
3. HMT, "Production Technology hand book" Tata-McGraw hill publications.
4. Ravi B., " Metal casting: Computer Aided Design and Analysis", prentice-hall of India, 2005
5. Weller E.J., "nontraditional Machining process" society of Manufacturing Engineers, Dearban Michigan
6. Amsteal, Philip, Begman, " Manufacturing processes",John Willey and sons 8th edition
7. Mishra P.K., "Non-traditional Machining Processes", Narosa Publications
8. Heine R.W., Loper C.R., Rosenthal P.C., "Principles of Metal Castings", and tata-McGraw Hill, New Delhi,1991
9. Mukherjee P.C., "Metal Casting Technology", Oxford and IBH, 1979
10. Ghosh A., Malik A.K., "Manufacturing Science", East-West Press, 1985

(MME 653) Engineering Experimental Techniques

Teaching Scheme:
Lectures: 03 h/week
Tutorials: 01 h/week
Credit: 4

Examination Scheme:
Theory Paper: 80 Marks (3 h)
Class Test: 20 Marks (1h)

Unit Contents

1)Basic Concept: Definition of terms, calibration, standards, dimensions and units, the generalized measurement system, basic concepts in dynamic measurements, system response, distortion, impedance matching, experimental planning. **8**

2)Analysis of experimental data: causes and types of experimental errors, uncertainty analysis, evalution of uncertainties for complicated data reduction, statistical analysis of experimental data, probability distribution, the Gaussian, normal error distribution, probability graph paper, the chisquare test of goodness of fit, the method of least square, the correlation coefficient, standard deviation of mean, t-distribution, Graphical analysis and curve fitting, general consideration in data analysis. **10**

3)Force Torque and Strain Measurements: Mass balance measurement, elastic elements of force measurement, torque measurement, stress strain measurement, various types of strain gauges. **8**

4)Motion and Vibration Measurement: simple vibration instrument, practical considerations of seismic instruments, sound measurements. **6**

5)Data Acquisition and processing: The general data acquisition system, signal conditioning, data transmission, analog to digital to analog conversions, data storage and display, the program as substitute for wired logic. **8**

Reference Books

1. Holman J.P., "Experimental Methods of Engineeris", 6th ED, McGraw Hill publications.
2. Jain R.K., "Mechanical Instruments", Khanna Publishers, New Delhi

(MME 691-A) Finite Element Methods (FEM)

Teaching Scheme:
Lectures: 03 h/week
Tutorials: 01 h/week
Credit: 4

Examination Scheme:
Theory Paper: 80 Marks (3 h)
Class Test: 20 Marks (1h)

Unit Contents

1) Introduction to Finite Difference Method and Finite Element Method, Advantages and disadvantages, Mathematical formulation of FEM, Variational and Weighted residual approaches. **8**

2) Shape functions, Natural co-ordinate system, Element and global stiffness matrix, Boundary conditions, Errors, Convergence and patch test, Higher order elements. **8**

3) Application to plane stress and plane strain problems, Axi-symmetric and 3D bodies, Plate bending problems with isotropic and anisotropic materials, Structural stability, Other applications e.g., Heat conduction and fluid flow problems. Idealisation of stiffness of beam elements in beamslab problems. **8**

4) Applications of the method to materially non-linear problems, Organisation of the Finite Element programmes, Data preparation and mesh generation through computer graphics, Numerical techniques, 3D problems. **8**

5) FEM an essential component of CAD, Use of commercial FEM packages, Finite element solution of existing complete designs, Comparison with conventional analysis. **8**

Reference Books:

1. O.C. Zienkiewicz and R.L. Taylor, "The Finite Element Method", McGraw Hill
2. J. N. Reddy, "An Introduction to Finite Element Method", McGraw Hill
3. K.J. Bathe, "Finite Element Procedure in Engineering Analysis", McGraw Hill
4. C.S. Krishnamoorthy, "Finite Element Analysis", Tata McGraw Hill
5. R.D. Cook, D.S. Malcus and M.E. Plesha, "Concepts and Application of Finite Element Analysis", John Wiley
6. T.R Chandragupta and A.D. Belegundu, "Introduction to Finite Elements in Engineering", Prentice Hall India
7. O.C. Zenkiewicy & Morgan, " Finite Element and Approximation"

(MME 692-A) Mechanical Vibrations

Teaching Scheme:
Lectures: 03 h/week
Tutorials: 01 h/week
Credit: 4

Examination Scheme:
Theory Paper: 80 Marks (3 h)
Class Test: 20 Marks (1h)

Unit Contents

1 Introduction: Characterization of engineering vibration problems, Review of single degree freedom systems with free, damped and forced vibrations. **8**

2 Two-degree of Freedom Systems: Principal modes of vibration, Spring coupled and mass coupled systems, Forced vibration of an undamped close coupled and far coupled systems, Undamped vibration absorbers, Forced damped vibrations, Vibration isolation. **8**

3 Multi-degree Freedom systems: Eigen-value problem, Close coupled and far coupled systems, Orthogonality of mode shapes, Modal analysis for free, damped and forced vibration systems, Approximate methods for fundamental frequency- Rayleigh's, Dunkerely, Stodola and Holzer method, Method of matrix iteration, Finite element method for close coupled and far coupled systems. **8**

4 Continuous systems: Forced vibration of systems governed by wave equation, Free and forced vibrations of beams/ bars. **10**

5 Transient Vibrations: Response to an impulsive, step and pulse input, Shock spectrum **Non-linear Vibrations:** Non-linear systems, Undamped and forced vibration with non-linear spring forces, Self-excited vibrations. **6**

Reference Books:

1. J.S. Rao and K. Gupta, "Theory and practice of Mechanical Vibrations", New Age International
2. G.K. Groover, "Mechanical Vibrations", Nem Chand & Brothers.
3. V. Ramamurti, "Mechanical Vibration", Practice, Narosa Publications
4. V.P. Singh, "Mechanical Vibrations", Dhanpat Rai & sons
5. R.V. Dukkipati & J. Srinivas, "Textbook of Mechanical Vibrations", Prentice Hall of India

(MME 691-B) Computer Aided Design (CAD)

Teaching Scheme:
Lectures: 03 h/week
Tutorials: 01 h/week
Credit: 4

Examination Scheme:
Theory Paper: 80 Marks (3 h)
Class Test: 20 Marks (1h)

Unit Contents

1) **Product design process**: Importance of design, design process, technological innovation and the design process, Team behavior and tools; Embodiment design: Product architecture, configuration of design, parametric design, Industrial design, Human factors design, Design for X (DFX). **4**

2) **CAD: Introduction**, Role of CAD, CAD system architecture, Hardware and software for CAD, Software modules, ICG, Graphics Software, Ground rules for design of GS, functions of GS, modeling and simulation, Solid modeling methods. **4**

3) An overview of modeling software: like UG/NX, Solid Works, Autodesk Inventor, Professional, AutoCAD, PRO/E, CATIA: Capabilities, Modules, Coordinate systems, Sketching tools, solid modeling tools, surface modeling tools, expression/parameters toolbox, data exchange tools, API and customization facilities. **8**

4) **Geometric transformations**: 2D and 3D; transformations of geometric models like translation, scaling, rotation, reflection, shear; homogeneous representations, concatenated representation; Orthographic projections. **4**

5) **CAD/CAM Data exchange and data storage**: Introduction, graphics and computing standards, data exchange standards like IGES, STEP, Model storage - Data structures - Data base considerations – Object oriented representations - Organizing data for CIM applications - Design information system. **4**

6)Mathematical representations of solids: Fundamentals, Solid models, Classification of methods of representations, half spaces, boundary representation, CSG, sweep representations, Octree representations, primitive instancing, cell decomposition, spatial occupancy enumeration. **6**

7)Mathematical representations of curves and surfaces: Curve representation, Parametric representation of analytic and synthetic curves; Surface models, Surface representations, Parametric representation of analytic and synthetic surfaces Assembly modeling: Representation, mating conditions, representation schemes, generation of assembling sequences. **5**

8)AI approaches and applications in CAD, Knowledge Based Engineering, OpenGL, Introduction to Advanced visualization topics in CAD like Modern representation schemes like FBM, PM, Feature recognition, Design by features, Tolerance modeling, System customization and design automation, Open Source CAD like Open CASCADE. **5**

Reference Book

1. Chris McMahon and Jimmie Browne, CAD/CAM – Principle Practice and Manufacturing Management, Addision Wesley England, Second Edition, 2000.

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2. Ibrahim Zeid, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
3. Dieter George, Engineering Design – A materials and processing approach, McGraw Hill Publishers, 2000
4. Ibrahim Zeid, Matering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
5. Rogers, D.F. and Adams, A., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
6. P.Radhakrishnan, S.Subramanayan and V.Raju, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
7. Groover M.P. and Zimmers E. W., CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
8. Dr. Sadhu Singh, Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi,

(MME 692-B) Computer Integrated Manufacturing (CIM)

Teaching Scheme:
Lectures: 03 h/week
Tutorials: 01 h/week
Credit: 4

Examination Scheme:
Theory Paper: 80 Marks (3 h)
Class Test: 20 Marks (1h)

Unit Contents

1) Introduction: The meaning and origin of CIM- the changing manufacturing and management scene - External communication - islands of automation and software-dedicated and open systems-manufacturing automation protocol - product related activities of a company- marketing engineering - production planning - plant operations - physical distribution- business and financial management.**8**

2) Group Technology and Computer Aided Process Planning : History of group technology- role of G.T. in CAD/CAM integration - part families - classification and coding - DCLASS and MICLASS and OPITZ coding systems-facility design using G.T. - benefits of G.T. – cellular manufacturing. Process planning - role of process planning in CAD/CAM integration - approaches to computer aided process planning - variant approach and generative approaches - CAPP and CMPP process planning systems. **8**

3) Shop Floor Control and Introduction of FMS: Shop floor control-phases -factory data collection system -automatic identification methods- Bar code technology-automated data collection system. FMS-components of FMS - types -FMS workstation -material handling and storage systems-FMS layout -computer control systems-application and benefits. **8**

4 CIM Implementation and Data Communication: CIM and company strategy – system modeling tools -IDEF models - activity cycle diagram CIM open system architecture (CIMOSA) - manufacturing enterprise wheel-CIM architecture- Product data management-CIM implementation software. Communication fundamentals- local area networks -topology -LAN implementations – network management and installations. **8**

5 Open System and Database For CIM: Open systems-open system inter connection - manufacturing automations protocol and technical office protocol (MAP /TOP) Development of databases -database terminology- architecture of database systems-data modeling and data associations -relational data bases - database operators - advantages of data base and relational database. **8**

Reference Books:

1. David D.Bedworth, Mark R.Hendersan, Phillip M.Wolfe "Computer Integrated Design and Manufacturing", McGraw-Hill Inc.
2. Yorem Koren, "Computer Integrated Manufacturing System", McGraw-Hill, 1983.
3. Mikell.P.Groover "Automation, Production Systems and computer integrated manufacturing", Pearson Education 2001.
4. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall International, 1986.

5. Roger Hanman "Computer Intergrated Manufacturing", Addison – Wesley, 1997.
6. Mikell.P.Groover and Emory Zimmers Jr., "CAD/CAM", Prentice Hall of India Pvt. Ltd., New Delhi-1, 1998.
7. Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall India, 2003.
8. Radhakrishnan P, Subramanyan S.and Raju V., "CAD/CAM/CIM", 2nd Edition New Age International (P) Ltd., New Delhi, 2000.

(MME 691-C) Computational Fluid Dynamics (CFD)

Teaching Scheme:
Lectures: 03 h/week
Tutorials: 01 h/week
Credit: 4

Examination Scheme:
Theory Paper: 80 Marks (3 h)
Class Test: 20 Marks (1h)

Unit Contents

1)Introduction: CFD as the third dimension of fluid mechanics, Numerical Discretization methods such as Finite Difference, FEM and FVM, why FVM as preferred method in CFD. **8**

2)Basic Equations of Fluid Dynamics: Potential flow, Nonlinear potential flow, Inviscid flows and viscous flows, Navier stokes equations, primitive variable vs conversation form, dimensional form vs non dimensionalform. **8**

3)Numerical Methods for conversion- diffusion equation: upwinding and central difference schemes, stability condition in terms of courant number. **8**

4)Nemerical Methods for Inviscid Flows: Characteristics form of equations, flux difference splitting, application to 2D flows such as flow through a nozzle. **8**

5)Numerical methods for Incompressible flows: the continuity equation divergence constraint, poisson equation for pressure, schemes such as simple due to patankar and spalding. **8**

Reference Books

1. Veersteeg and Malalasekara, CFD: the finite volume method. Prentice Hall, 1996
2. Anderson, Tannehill and Pletcher: Computaional Fluid Mechanics and Heat Transfer, Hemisphere Publishers, 1984
3. C.A.J Fletcher, computational methods for fluid dynamics: vol 1 and 2. Springer verlag, 1987
4. C. Hirscha, Numerical Computational of Internal and External flows Vol.1and 2
5. D.C. Wilcox, Turbulence Modeling for CFD, DCW Industries

(MME 692-C) Refrigeration and Cryogenic Systems

Teaching Scheme:
Lectures: 03 h/week
Tutorials: 01 h/week
Credit: 4

Examination Scheme:
Theory Paper: 80 Marks (3 h)
Class Test: 20 Marks (1h)

Unit Contents

1 Vapour Compression refrigeration: system:- Simple systems, Multi-evaporator system; Multi expansion system; Cascade systems; Study of P-h; T-s; h-s and T-h charts for various refrigerants, Concept of Heat Pump **Refrigerant**: Designation, selection, desirable properties, refrigerant blends, secondary refrigerants, refrigerant recycling, reclaim and charging, alternative refrigerants, Refrigerantlubricant mixture behavior, ODP, GWP concepts. **8**

2 Vapour absorption refrigeration: Standard cycle and actual cycle, thermodynamic analysis, LiBr- water, NH3-water systems, Three fluid absorption systems, half effect, single effect, singledouble effect, double effect, and triple effect system. **Non-convention refrigeration system (Principle and thermodynamic analysis only):** Thermoelectric refrigeration, thermo-acoustic refrigeration, adsorption refrigeration, steam jet refrigeration, vortex tube refrigeration, and magnetic refrigeration. **8**

3 Compressor rating and selection- Hermetic, reciprocating, screw, Scroll and centrifugal Compressors based on applications. **Evaporators**: types, thermal design, effect of lubricants accumulation, draining of Lubricants, selection and capacity control **Condenser:** types, thermal design, purging, selection and capacity control. **8**

4 Introduction to Cryogenics: Importance of cryogenics , Development history of cryogenics, Application areas of cryogenics', Material properties at Cryogenic Temperatures, super conductivity applications, Cryogenics in space Industries. Cryogenics in Aviation and Aerospace Industry, Cryobiology. **8**

5 Liquefaction systems : Carnot Liquefaction system, F.O.M. and Yield of Liquefaction system, Inversion Curve – Joule Thomson Effect. Linde system, Linde-Hampson System, Precooled Linde Hampson System, Claudes system, Dual pressure System, Kapitza system, Heylandt system, Philips machine. **8**

References Books

1. R.J. Dossat, "Principles of refrigeration", Pearson Education Asia
2. C.P. Arora, "Refrigeration and Air Conditioning", McGraw-Hill
3. W.F. Stoecker, "Industrial Refrigeration Handbook", McGraw-Hill
4. P.C. Koelet, "Industrial Refrigeration: Principles, design and applications", Mcmillan
5. ASHRAE Handbook (i) Fundamentals (ii) Refrigeration
6. ISHRAE handbooks

7. Mamata Mukhopadhyay, "Fundamentals of Cryogenic Engineering", PHI Learning Private limited.
8. R. Baron, "Cryogenic Systems", Oxford University Press.
9. A Bose and P. sengupta, "Cryogenics applications and progress", McGraw-Hill

(MME 671) Lab-III

Teaching Scheme:
Practical: 04 hrs/week
Credit: 2

Examination Scheme:
Term Work: 50 Marks

Assignments shall be based on five theory subjects of semester-II (Two on each subject). The marks will be awarded by the concerned subject teachers.

(MME 672) LAB – IV

Teaching Scheme:
Tutorials/Practical: 02 hrs/week
Credit: 1

Examination Scheme:
Viva – voce: 50 Marks.

The Lab-IV work consists of the process analysis using relevant software through,

- Product Identification
- Appropriate process selection
- Process details Verification
- Analysis

The candidate will deliver the work in front of two examiners (one internal and other appointed by the university)

(MME 673) SEMINAR – II

Teaching Scheme:
Tutorials/Practical: 02 h/week
Credit: 1

Examination Scheme:
Viva – voce: 50 Marks.

Seminar –II: It shall be based on the literature survey on any topic, which may lead to dissertation in that area. It will be submitted as a report.

The candidate will have to deliver a seminar presentation before the examiners, one of them will be guide and the other will be examiner appointed by the university.

(The Dissertation consist of two parts as Part-I and Part-II)

Semester – III

(MME 731) DISSERTATION PART – I

Teaching Scheme:	**Examination Scheme:**
Contact Hours (CH): 12 hrs/week	**Term Work:** 50 Marks
Credit: 12	**Viva – voce:** 50 Marks

The dissertation shall consist of a report on any research work done by the candidate or a comprehensive and critical review of any recent development in the subject or detailed report of the project work consisting of a design and / or development work that the candidate has executed. The report must include comprehensive litterateur work on the topic selected for dissertation.

Term work:

The dissertation part I will be in the form of seminar report on the project work being carried out by the candidate and will be assessed by two examiners appointed by the university, one of whom will be the guide and other will be a senior faculty member from the department.

Viva-voce:

The dissertation part I will be in the form of seminar report on the project work being carried out by the candidate and will be assessed by two examiners appointed by the university, one of whom will be the guide and other will be an external examiner.

Semester – IV

(MME 781) DISSERTATION PART – II

Teaching Scheme:
Contact Hours (CH): 20 hrs/week
Credit: 20

Examination Scheme:
Term Work: 100 Marks
Viva – voce: 200 Marks

The dissertation part - II will be in continuation of dissertation part - I and shall consist of a report on the research work done by the candidate or a comprehensive and critical review of any recent development in the subject or detailed report of the project work consisting of a design and / or development work that the candidate has executed. The examinee shall submit the dissertation in triplicate to the head of the institution duly certified by the guide and the concerned head of department and the Principal that the work has been satisfactorily completed.

Term work:

The dissertation will be assessed by two internal examiners appointed by the Institute, one of whom will be the guide and other will be a senior faculty member from the department.

Viva-voce:

It shall consist of a defense presented by the examinee on his work in the presence of examiners appointed by the university, one of whom will be the guide and other will be an external examiner.