

S-25 March, 2013 AC after Circulars from Circular No.153 & onwards

- 65 -

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY**CIRCULAR NO. ACAD/NP/M.Tech./Syllabi/188/2013**

It is hereby informed to all concerned that, on recommendation of the Faculty of Engineering and Technology, the Hon'ble Vice-Chancellor has accepted the **"Revised Syllabi with Cumulative Grade Point Average [CGPA] for [1] M.Tech. [Food Processing Technology], [2] M.Tech. [Computer Science & Technology] and [3] M.Tech. [Mechanical]"** on behalf of the **Academic Council Under Section-14(7) of the Maharashtra Universities Act, 1994** as appended herewith.

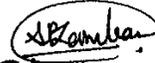
This is effective from the Academic Year 2013-2014 and onwards.

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/ M.TECH./
SYLLABI / 2013/14083-91
V.C.14[7] A-08.

Date:- 14-06-2013.

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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 all syllabi on University Website [www.bamu.net].**

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



Syllabus of M. Tech. (Mechanical)

[Effective from Academic Year 2013 - 2014]

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 an 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.

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 = $2 \times 0.5 = 1$ credit

2 hours/week seminar = $2 \times 0.5 = 1$ credit

Dissertation seminar/Contact Hours = $1 \times 1 = 1$ 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.



1.6 Evaluation System

1. Semester Grade Point Average (SGPA) =

$$\frac{\text{SUM (course credits in passed courses X earned grade points)}}{\text{SUM (Course credits in registered courses)}}$$

2. Cumulative Grade Point Average (CGPA) =

$$\frac{\text{SUM (course credits in passed courses X earned grade points) of all Semester}}{\text{SUM (Course credits in registered courses) of all Semester}}$$

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 ≥ 8.25 and above
 - Ist Division : CGPA ≥ 6.75 and < 8.25
 - IInd Division : CGPA ≥ 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 ≥ 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

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

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

$$2. \text{ Cumulative Grade Point Average (CGPA)} = \frac{\text{Cumulative points earned in all passed courses} = 172 \text{ (past semester)} + 172 \text{ (this sem.)} = 344}{\text{Cumulative earned credits} = 24 \text{ (past semesters)} + 24 \text{ (this sem)} = 48}$$

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

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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	5.5	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.

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

Six Digit Code for a subject (PG Course)

Sr. No.	Digits →	1 2 3	4	5 6
	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
Rules & Eligibility		
II	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.
Evaluation method		
III	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

		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.

M.Tech..Mechanical

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
Proposed Teaching/Examination Scheme for the degree of Master of Technology (Mechanical)
w. e. f. Academic Year 2013-2014

Semester – I

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

*Elective Subjects:

Elective	Group A : Design	Group B : Production	Group C : Heat and Power
Elective-I (MTM 641A-C)	Machine Stress Analysis	Reliability & Maintenance Engineering	Advanced Thermodynamics
Elective-II (MTM 642A-C)	Kinematics: Dynamics & Synthesis	Non conventional Machining Processes	Advanced Heat Transfer

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

M.Tech.Mechanical

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
Proposed Teaching/Examination Scheme for the degree of Master of Technology (Mechanical)
w. e. f. Academic Year 2013-2014

Semester – II

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

*Elective Subjects:

Elective	Group A : Design	Group B : Production	Group C : Heat and Power
Elective-III (MTM 691A-C)	Finite Element Methods	Metal Forming Processes	Advanced IC Engines
Elective-IV (MTM 692A-C)	Advanced Mechanical Vibrations	Computer Integrated Manufacturing	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.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
Proposed Teaching/Examination Scheme for the degree of Master of Technology (Mechanical)
 w. e. f. Academic Year 2013-2014

Semester – III

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

Semester – IV

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

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

M.Tech.Mechanical

(MTM 601) ADVANCED OPTIMIZATION TECHNIQUES**Teaching Scheme:**

Lectures: 03 hrs /week

Tutorials: 01 hrs /week

Credit: 4

Examination Scheme:

Theory Paper: 80 Marks (3 hrs)

Class Test: 20 Marks (1 hrs)

Units	Contents	Hrs.
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.

M.Tech.Mechanical

(MTM 602) MATERIAL SCIENCE**Teaching Scheme:****Lectures:** 03 hrs /week**Tutorials:** 01 hrs /week**Credit:** 4**Examination Scheme:****Theory Paper:** 80 Marks (3 hrs)**Class Test:** 20 Marks (1 hrs)

Unit	Contents	Hrs.
1	Materials and Classification: Solid materials- Classification, Ceramics, composites and metal glasses, selection and application of tool steel, Magnetic alloys, Copper, aluminum and magnesium alloys, Bearing alloys, Super hard materials, Plastics, Alloying techniques- Thermal, mechanical and chemical methods, Powder metallurgy techniques, Macro and micro analysis of materials, Macro analysis of ferrous and non ferrous materials, Dendritic structures, Segregation and bonding, Heterogeneity formed through treatment and mechanical working.	8
2	Mechanical Properties: Strengthening mechanism of materials, elements of dislocation theories, Strain hardening, Grain size control, Single crystal growth, Reinforcing fibres for polymers, Composite structure, determination of mechanical properties of materials, Dynamic tests, Fracture and toughness tests, Low temperature and high temperature tests, Creep characteristics, Hot hardness tests, Total intragranular cracking and aggressive media, Ceramics and composites, Insulation, Strength and aging of plastics.	8
3	Processing of Materials for Casting and Joining: Plastic working of materials, Strain hardening, Recovery and recrystallisation, Formability, Forgibility and drawability of materials, Powder processing of materials, Ceramic processing, Composite processing, Features controlling machinability of materials, thermal treatment for better machinability of metals, Universal mach inability index.	8
4	Modern Materials and Alloys: Super alloys-refractory materials, Ceramic and their applications, Low melting alloys, Advanced Composites-Particulate and dispersed composites, Metal matrix and ceramic matrix composites, Carbon-Carbon composites, Ti and Ni based alloys for gas turbine applications, Margining and cryogenic steels- Newer materials and their treatment for automobile applications, materials for Naval and nuclear systems. Smart and Nano materials.	10
5	Polymers and polymerization: Structure and properties of thermoplastics and thermo sets, Engineering applications, Property modifications, Mechanical, thermal behavior of composites with polymer matrix, ceramics glasses.	6

Reference Books:

1. P. Flinn and P.K. Trojan, "Engineering Materials and Applications", MIR Publications.
2. A.K Bhargava, "Engineering Materials: Polymers, Ceramics and Composites", Prentice Hall of India
3. Serope Kalpakjian, "Manufacturing processes for Engineering Materials", Wesley Publishing Co.
4. S.H. Avner, "An introduction to Physical Metallurgy", McGraw Hill
5. P. Rama Rao, "Advances in Materials and Their Applications", Wiley Eastern
6. Dieter G.E., "Mechanical Metallurgy", McGraw Hill

M.Tech.Mechanical

(MTM 603) MECHATRONICS**Teaching Scheme:**

Lectures: 03 hrs /week

Tutorials: 01 hrs /week

Credit: 4

Examination Scheme:

Theory Paper: 80 Marks (3 hrs)

Class Test: 20 Marks (1 hrs)

Unit	Contents	Hrs.
1	Industrial sensors: Characteristics of sensors, Selection criteria, study and application of sensors like Position, Velocity, Acceleration, Vibration, Proximity, Force, Pressure, Temperature, Vision, etc.	8
2	Industrial actuators: Analog and Discrete actuators, Mechanical actuation systems, Hydraulic actuation systems, Pneumatic actuation systems, Electrical actuation systems, Robotic actuators, Selection criteria.	8
3	Modelling and Simulation: Role of modeling in mechatronics design, Modeling electro-mechanical dynamic systems, Transfer functions, MEMS- modeling, Introduction to MatLab and Simulink	8
4	Computer and Control: Role of controls in mechatronics, Computer based instrumentation system, Control schemes, Control with embedded controllers and Programmable Logic Controller, CNC.	8
5	Designing Mechatronics systems: Designing issues, Case studies of mechatronics systems like internal combustion engines with drive train, Semi-active wheel suspension, Camera winder, Disk drive, Closed-loop speed control mechanism, DC motor control, etc.	8

Reference Books:

1. W. Bolton, "Mechatronics", Pearson Education Asia
2. Wolfram Stadler, "Analytical Robotics and Mechatronics", McGraw Hill
3. Dan Neculescu, "Mechatronics", Pearson Education Asia
4. Editor-in-Chief- Robert H. Bishop, "The Mechatronics handbook", CRC Press,
5. Mechatronics, AMT
6. A.P. Mahind, "Introduction to Digital Computer Electronics", TMH
7. E.O. Doebelin, "Measurement Systems", McGraw Hill
8. B.C. Kuo, Ogata, "Automatic Control Systems", PHI
9. Lawrence J K, "Understanding Electromechanical Engineering; An Introduction to Mechatronics", PHI
10. Nadim Maluf and Kirt Williams, "An introduction to microelectromechanical systems", Artech House Publication, London.

M.Tech.Mechanical

(MTM 641-A) MACHINE STRESS ANALYSIS**Teaching Scheme:****Lectures:** 03 hrs /week**Tutorials:** 01 hrs /week**Credit:** 4**Examination Scheme:****Theory Paper:** 80 Marks (3 hrs)**Class Test:** 20 Marks (1 hrs)

Unit	Contents	Hrs.
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 theorems, 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, Prandtl'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

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(MTM 641-B) RELIABILITY AND MAINTENANCE ENGINEERING**Teaching Scheme:****Lectures:** 03Hrs/Week**Tutorials:** 01Hrs/Week**Credits:** 4**Examination Scheme:****Theory Paper:** 80 Marks (3 Hrs.)**Class Test:** 20 Marks

Unit	Contents	Hrs.
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 – exponential, Weibull, gamma, Normal, log normal, extreme value, model selection for components failure, failure analysis.	8
2	System Reliability: Series, parallel and mixed configurations. k-out-of-n-structure. Economics of introducing a standby or redundancy into a production system, optimum design configuration of a series/parallel system: maximizing reliability subject to budgetary constraint optimum level of active parallel redundancy for an equipment with components subject to failure.	6
3	Reliability design: Design for reliability, design process, assessment methodology, reliability allocation, reliability improvement, selection of components to improve system reliability Reliability Testing: Product Testing, Reliability Life Testing, Burn –In Testing, Accelerated Life testing.	8
4	Maintenance Engineering: Fundamentals of Maintenance Engineering, importance of Maintenance, types of maintenance policies: corrective maintenance, preventive maintenance, condition monitoring and its techniques. Emerging trends in maintenance-Proactive Maintenance, Total Productive Maintenance (TPM). Reliability Centered Maintenance (RCM), RCM approach, RCM methodology, Application of RCM: examples and computers implementation.	8
5	Replacement Decisions: Economic models, block replacement policy, age replacement policy, replacement policies to minimize downtime, economics of preventive maintenance. Inspection Decisions: Optimal inspection frequency to profit maximizing, minimization of downtime and availability maximization.	10

Reference Books:

1. An Introduction to Reliability and Maintainability Engineering by Charles E. Ebeling, TMH Publication, New Delhi.
2. Concepts in Reliability in Engineering by L. S. Srinath, Affiliated East West Press.
3. Terotechnology: Reliability Engineering & Maintenance Management by S. K. Basu and B. Bhadury - Asian Books Private Limited
4. Maintenance, Replacement and Reliability- Theory and Applications by A.K.S. Jardine and A.H.C. Tsang, CRC Press, Taylor and Francis, New York.
5. Maintainability, Maintenance and Reliability for Engineers by B.S. Dhillon, CRC Press, Taylor and Francis, New York.
6. Reliability in Engineering Design by K. C. Kapur and L. R. Lumberson, John Willey and sons.
7. Maintenance Engineering handbook by R. Keith Mobley, Lindley R. Higgins, Darrin J. Wikoff.-7th ed., McGraw-Hill.

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Additional References

1. **Reliability Engineering** by E.A. Elsayed, John Wiley & Sons, Inc, New Jersey
2. **Reliability Engineering-Specification and Performance**, Springer –Verlag London Limited
3. nptel.iitm.ac.in/
4. ocw.mit.edu/
5. see.stanford.edu/
6. **Reliability Engineering and System Safety** (Elsevier)
7. **International Journal of Reliability, Quality and Safety Engineering** (World Scientific Publishing Company)
8. **International Journal of Performability Engineering** (RAMS Consultant)
9. **Quality and Reliability Engineering International** (Wiley Online Library)
10. **Reliability Engineering** (Elsevier)
11. **Journal of Quality in Maintenance Engineering** (Emerald)

M.Tech.Mechanical

(MTM 641-C) ADVANCED THERMODYNAMICS**Teaching Scheme:**

Lectures: 03 hrs /week

Tutorials: 01 hrs /week

Credit: 4

Examination Scheme:

Theory Paper: 80 Marks (3 hrs)

Class Test: 20 Marks (1 hrs)

Unit	Contents	Hrs.
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 & P- T 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

M.Tech.Mechanical

(MTM 642-A) KINEMATICS: DYNAMICS AND SYNTHESIS**Teaching Scheme:****Lectures:** 03 hrs /week**Tutorials:** 01 hrs /week**Credit:** 4**Examination Scheme:****Theory Paper:** 80 Marks (3 hrs)**Class Test:** 20 Marks (1 hrs)

Unit	Contents	Hrs.
1	Introduction: Concepts related to kinematics and mechanisms, Degrees of freedom, Grubler's Criteria, Transmission and Deviation angles, Mechanical advantage.	8
2	Kinematic Synthesis: Type, number and dimensional synthesis. Spacing of accuracy points, Chebyshev polynomials, Motion and function generation, Graphical synthesis with two, three and four prescribed motions and points, The complex number modeling in kinematic synthesis, The Dyad, Standard form, Freudentein's equation for three point function generation coupler curves, Robert's law, Cognates of the slider crank chain.	8
3	Path Curvature Theory: Fixed and moving centrode, Inflection points and inflection circle circle, Euler'-savary Equation, Bobillier's and Hartsman construction.	8
4	Dynamic Force Analysis: Introduction, Inertia force in linkages, Kineto static analysis by superposition and matrix approach, Time response of mechanisms, Force and moment balancing of linkages.	8
5	Spatial Mechanism: Introduction to 3-dimensional mechanisms, Planar Finite, Rigid body and spatial transformation, Analysis of spatial mechanisms.	8

Reference Books:

1. Tao D.C., "Fundamentals of applied Kinematics", Addison Wesley, USA 1967
2. R. Hartenberg and Denavit, "Kinematic Synthesis of Linkages", McGraw Hill
3. A.K. Mallik and A. Ghosh, "Kinematic Analysis and Synthesis of Mechanisms", CRC Press
4. A.K. Mallik and A. Ghosh, "Theory of Mechanisms", East west Press
5. Hirschern J, "Kinematics and Dynamics of Plane Mechanisms", McGraw Hill, NY
6. Soni A.H., "Mechanism Synthesis & Analysis", McGraw Hill

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(MTM 642-B) NON CONVENTIONAL MACHINING PROCESSES**Teaching Scheme:**

Lectures: 03 hrs /week

Tutorials: 01 hrs /week

Credit: 4

Examination Scheme:

Theory Paper: 80 Marks (3 hrs)

Class Test: 20 Marks (1 hrs)

Unit	Contents	Hrs.
1	Introduction: Introduction: Limitations of conventional manufacturing processes need of unconventional manufacturing processes & its classification and its future possibilities. <ul style="list-style-type: none"> • Introduction to unconventional machining processes, their needs and classification. • Brief introduction to the type of energy source employed in AJM, USM, WJM, EDM, ECM, ECG, LBM, PAM, EBM. 	6
2	Mechanical Energy Based Processes Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining Ultrasonic Machining. (AJM, WJM, AWJM and USM). Working Principles – equipment used – Process parameters – MRR-Variation in techniques used – Applications.	8
3	Electrical Energy Based Processes Electric Discharge Machining (EDM)- working Principles-equipments-Process Parameters-MRR- electrode / Tool – Power Circuits-Tool Wear – Dielectric – Flushing – Wire cut EDM – Applications.	8
4	Thermal Energy Based Processes Laser Beam machining (LBM), plasma Arc machining (PAM) and Electron Beam Machining (EBM). Principles-Equipment- Types-Beam control techniques – Applications.	8
5	Electrochemical and Chemical Metal Removal Process: Introduction, Study of ECM machine, Elements of ECM process : Cathode tool, Anode work piece, source of DC power, Electrolyte, Chemistry of the process ECM process characteristics – Material removal rate, Accuracy, Surface finish. ECM Tooling: ECM tooling technique, Tool & insulation materials, Tool size Electrolyte flow arrangement, Handling of slug, Applications such as Electrochemical turning, Electrochemical Grinding, Electrochemical Honing, deburring, Advantages, Limitations. Chemical Machining (CHM): Introduction, Elements of process Chemical blanking process:-Preparation of workpiece. Preparation of masters, masking with photo resists, etching for blanking, applications of chemical blanking, chemical milling (Contour machining) :-Process steps – masking, Etching, process characteristics of CHM :-material removal rate accuracy, surface finish, Hydrogen embrittlement, Advantages & application of CHM.	10

Recommended Books:

1. Pandey P.C. and Shan H.S. “Modern Machining Processes”, Tata McGraw-Hill, New Delhi
2. Ghosh A. and Mallik A. K., “Manufacturing Science”, East-West Press Pvt. Ltd. New Delhi.
3. Jain V.K., “Advanced Machining Processes”, Allied Publishers Pvt. Ltd., New Delhi

Reference Books:

1. Mc Geough, “Advanced Methods of Machining”, Chapman and Hall, London
2. Paul De Garmo, J.T.Black, and Ronald A. Kohser, “Material and Processes in Manufacturing”, Prentice Hall of India Pvt. Ltd., New Delhi.

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3. Benedict. G.F, Nontraditional Manufacturing Processes, Marcel Dekker Inc., New York (1987).
(MTM 642-C) **ADVANCED HEAT TRANSFER**

Teaching Scheme:

Lectures: 03 hrs /week
Tutorials: 01 hrs /week
Credit: 4

Examination Scheme:

Theory Paper: 80 Marks (3 hrs)
Class Test: 20 Marks (1 hrs)

Unit	Contents	Hrs.
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

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6 Sarit K. Das, "Engineering Heat & Mass Transfer", Dhanpat Rai
(MTM 621) LAB – I

Teaching Scheme:

Practical: 04 hrs/week

Credit: 2

Examination Scheme:

Term Work: 50 Marks

Lab work consists of two parts as below:

Part A: The candidate will deliver an industrial case study in front of two examiners (one internal and other appointed by the Principal)

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

(MTM 622) LAB – II

Teaching Scheme:

Practical: 02 hrs/week

Credit: 1

Examination Scheme:

Viva – voce: 50 Marks

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

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

Practical Examination should be based on Viva-Voce on the above assignments/ experiments.

(MTM 623) SEMINAR – I

Teaching Scheme:

Tutorials: 02 hrs/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.

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(MTM 651) ADVANCED MACHINE DESIGN**Teaching Scheme:**

Lectures: 03 hrs /week

Tutorials: 01 hrs /week

Credit: 4

Examination Scheme:

Theory Paper: 80 Marks (3 hrs)

Class Test: 20 Marks (1 hrs)

Unit	Contents	Hrs.
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"

M.Tech.Mechanical

(MTM 652) ADVANCED MANUFACTURING PROCESSES**Teaching Scheme:****Lectures:** 03 hrs /week**Tutorials:** 01 hrs /week**Credit:** 4**Examination Scheme:****Theory Paper:** 80 Marks (3 hrs)**Class Test:** 20 Marks (1 hrs)

Unit	Contents	Hrs.
1	Metal cutting: Need for rational approach to the problem of cutting metals–Observation in metal cutting, Energy considerations in machining, Modern theories in mechanics of cutting, Review of Merchant and Lee Shaffer theories, critical comparison, Measurement of cutting forces–Classification of cutting force dynamometers, Lathe tool dynamometer, Drill, Milling and grinding dynamometer, Heat distribution in machining–Effects of various parameters on temperature, Method of temperature measurement in machining, Hot machining, Cutting fluids.	10
2	Tool Materials, Tool Life and Tool Wear & Wear Mechanisms: Essential requirements of tool materials, Developments in tool materials, ISO specifications for inserts and tool holders, Tool life, Conventional and accelerated tool life tests, Concepts of machinability and machinability index, Economics of machining, Reasons for failure of cutting tools, Forms of wear, Chatter in machining, Chatters types, Mechanism of chatter based on force v/s Speed graph, Mechanism of grinding, Various parameters affecting grinding process, Machinability data systems.	6
3	Sheet Metal Forming & Special Forming Processes: Review of conventional processes, HERF techniques, Super plastic forming techniques, Principles and Process parameters, Advantages, applications and limitations of HERF techniques, Orbital forging, Isothermal forging, Hot and cold iso-static pressing, High speed extrusion, Rubber pad forming, Water hammer forming, Fine blanking.	6
4	Unconventional and special Welding Processes and Automation: Friction welding, Explosive welding, Diffusion bonding, High frequency induction welding, Ultrasonic welding, Electron beam welding, Laser beam welding, Automation in welding, Welding robots, Overview of automation of welding in aerospace, Nuclear, Surface transport vehicles and under water welding.	8
5	Special Casting Processes & Recent Advances in Casting: Shell moulding, precision investment casting, CO ₂ moulding, Centrifugal casting, Die and continuous casting, Low pressure die casting, Squeeze casting, Full mould casting process, Layout of mechanized foundry, sand reclamation, Material handling in foundry, Pollution control in foundry, recent trends in casting, Computer aided design of casting.	10

Reference Books:

1. M.C. Shaw, "Metal Cutting Principles", Oxford Clarendon Press
2. Bhattacharya, "Metal Cutting Theory and Practice", New Central Book Agency
3. B.L. Juneja and G.S. Sekhon, "Fundamentals of Metal Cutting and Machine Tools", New Age International
4. G. Kuppaswamy, "Principles of Metal Cutting", Universities Press
5. D.G. Boothroy and W.A. Knight Marcel Dekker, "Fundamentals of Machining and Machine Tools", NY
6. H. Loper and Rosenthal, "Fundamentals of Metal Casting", Tata McGraw Hill
7. T Altan, Soo-Ik-Oh and H.L. Gegel, "Metal forming-Fundamentals and Applications", American Society of Metals, Metal Park, 1983.

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(MTM 653) COMPUTATIONAL FLUID DYNAMICS**Teaching Scheme:**

Lectures: 03 hrs /week

Tutorials: 01 hrs /week

Credit: 4

Examination Scheme:

Theory Paper: 80 Marks (3 hrs)

Class Test: 20 Marks (1 hrs)

Unit	Contents	Hrs.
1	Conservation Laws of Fluid Motion and Boundary Conditions: Governing equations of fluid flow and heat transfer, Equations of state, Navier-Stokes equations for a Newtonian fluid	8
2	Classification of physical behavior, Classification of fluid flow equations, Auxiliary conditions for viscous fluid flow equations. Turbulence and its Modelling: Transition from laminar to turbulent flow, Effect of turbulence on time-averaged Navier-Stokes equations, Characteristics of simple turbulent flows, Free turbulent flows, Flat plate boundary layer and pipe flow, Turbulence models, Mixing length model, The k-e model, Reynolds stress equation models, Algebraic stress equation models.	8
3	The Finite Volume Method for Diffusion Problems: Introduction, one-dimensional steady state diffusion, two-dimensional diffusion problems, three-dimensional diffusion problems, discretised equations for diffusion problems.	8
4	The Finite Volume Method for Convection-Diffusion Problems: Steady one-dimensional convection and diffusion, The central differencing scheme, Properties of discretisation schemes-Conservativeness, Boundedness, Transportiveness, Assessment of the central differencing scheme for convection-diffusion problems, The upwind differencing scheme,	8
5	One-dimensional unsteady heat conduction, Discretisation of transient convection-diffusion equation, Solution procedures for unsteady flow calculations, Implementation of Inlet, outlet and wall boundary conditions, constant pressure boundary condition.	8

Reference Books:

1. Anderson, J.D. Jr., "Computational Fluid Dynamics".- McGraw Hill Inc., 1995
2. Hoffman, K.A. and Chai, S.T., "Computational Fluid Dynamics", Engineering Education System, Kanasa, USA, 1993
3. Chung, T.J., "Computational Fluid Dynamics", Cambridge University Press, 2003
4. John D. Anderson, "Computational Fluid Dynamics: The Basics with Applications", McGraw-Hill, New York, 1995.
5. Vivek V. Ranade, "Computational Flow Modeling for Chemical Reactor Engineering", Academic Press, San Diego, 2002

M.Tech.Mechanical

(MTM 691-A) FINITE ELEMENT METHOD

Teaching Scheme:

Lectures: 03 hrs /week
Tutorials: 01 hrs /week
Credit: 4

Examination Scheme:

Theory Paper: 80 Marks (3 hrs)
Class Test: 20 Marks (1 hrs)

Unit	Contents	Hrs.
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 beam-slab 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"

M.Tech.Mechanical

(MTM 691-B) METAL FORMING PROCESSES**Teaching Scheme:****Lectures:** 03 hrs /week**Tutorials:** 01 hrs /week**Credit:** 4**Examination Scheme:****Theory Paper:** 80 Marks (3 hrs)**Class Test:** 20 Marks (1 hrs)

Unit	Contents	Hrs.
1	Introduction: Stress/strain/strain-rate characteristics of materials, Yield criteria, classification of metal working processes, Formability and theory of sheet metal working, Friction and lubrication in metal working operation, Theories of friction and lubrication, Assessment of friction at interface.	10
2	Process Analysis: Various methods of analyzing the metal working processes (slip-line field theory, Upper bound solution, stab methods).	6
3	Mechanics of Forming Processes: Rolling-Determination of rolling pressure, roll separating force, driving torque and power, Power loss in bearings, Forging-Forces in strip forging and disc forging, Drawing-determination of force and power, Maximum allowable reduction, Deep drawing force analysis, Analysis of tube drawing process with fixed and moving mandrel, Tandem tube drawing, Bending- Determination of work load and spring back, Extrusion-Determination of work load from stress analysis and energy consideration, Power loss, Hydrostatic extrusion, Punching & Blanking-Mode of metal deformation and failure, 2D deformation model and fracture analysis, Determination of work force.	6
4	Hydrostatic Extrusion: Comparison with conventional extrusion, Pressure required extruding, variables affecting the process.	8
5	High Speed Forming: Classification, Comparison of low and high speed forming, operation problems in high speed forming operation, Introduction to high forming process such as explosive forming, Electrical and Mechanical high speed forming techniques.	10

Reference Books:

1. Rowe Arnold, "An Introduction to the Principles of Metal Working"
2. Avitzur, "Metal Forming Analysis", McGraw Hill
3. "Mathematical Simulation and Computer analysis of Thin Strip Rolling Mill Polukhin", MIR Publications
4. Johnson & Mellor Van Nostrand, "Plasticity for Mechanical Engineers".
5. "High Velocity Working of Metals", ASTM EEE
6. Ghosh & Mallik, "Manufacturing Science", Affiliated East-West.
7. S. Kumar, "Technology of Metal Forming Processes", Prentice Hall of India

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(MTM 691-C) ADVANCED I.C. ENGINES**Teaching Scheme:****Lectures:** 03 hrs /week**Tutorials:** 01 hrs /week**Credit:** 4**Examination Scheme:****Theory Paper:** 80 Marks (3 hrs)**Class Test:** 20 Marks (1 hrs)

Unit	Contents	Hrs.
1	Spark Ignition Engines: Mixture requirements, Fuel Induction systems, Stages of combustion, 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, super charging 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 simulation 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
9. www.lanl.gov/orgs/t/t3/codes/kiva/shtml
10. www.fluent.com/solution/brochures/ic-minibrochure-final.pdf

M.Tech.Mechanical

(MTM 692-A) ADVANCED MECHANICAL VIBRATIONS**Teaching Scheme:**

Lectures: 03 hrs /week

Tutorials: 01 hrs /week

Credit: 4

Examination Scheme:

Theory Paper: 80 Marks (3 hrs)

Class Test: 20 Marks (1 hrs)

Unit	Contents	Hrs.
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. Dukupati & J. Srinivas, "Textbook of Mechanical Vibrations", Prentice Hall of India

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(MTM 692-B) COMPUTER INTEGRATED MANUFACTURING**Teaching Scheme:****Lectures:** 03 hrs /week**Tutorials:** 01 hrs /week**Credit:** 4**Examination Scheme:****Theory Paper:** 80 Marks (3 hrs)**Class Test:** 20 Marks (1 hrs)

Unit	Contents	Hrs.
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. Yorem Koren, "Computer Integrated Manufacturing System", McGraw-Hill, 1983.
2. M. P. Groover "Automation, Production Systems and computer integrated manufacturing", Pearson Education 2001.
3. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall International, 1986.
4. David D. Bedworth, Mark R.Hendersan, Phillip M.Wolfe "Computer Integrated Design and Manufacturing", McGraw-Hill Inc.
5. Roger Hanman "Computer Intergrated Manufacturing", Addison – Wesley, 1997.
6. M. P. Groover and Emory Zimmers Jr., "CAD/CAM", PHI Pvt. Ltd., New Delhi, 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 Ed. New Age International (P).

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(MTM 692-C) REFRIGERATION AND CRYOGENIC SYSTEMS**Teaching Scheme:****Lectures:** 03 hrs /week**Tutorials:** 01 hrs /week**Credit:** 4**Examination Scheme:****Theory Paper:** 80 Marks (3 hrs)**Class Test:** 20 Marks (1 hrs)

Unit	Contents	Hrs.
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, Refrigerant-lubricant mixture behavior, ODP, GWP concepts	8
2	Vapour absorption refrigeration: Standard cycle and actual cycle, thermodynamic analysis, Li-Br-water, NH ₃ -water systems, Three fluid absorption systems, half effect, single effect, single-double 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

Reference 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

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(MTM 671) LAB – III**Teaching Scheme:**

Practical: 04 hrs/week

Credit: 2

Examination Scheme:

Term Work: 50 Marks

Lab work consists of two parts as below:

Part A: Software development based on theory subjects of semester-I. The candidate will deliver the work in front of two examiners (one internal and other appointed by the Principal)

Part B: 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.

(MTM 672) LAB – IV**Teaching Scheme:**

Practical: 02 hrs/week

Credit: 1

Examination Scheme:

Viva – voce: 50 Marks

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

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

A detailed report on the above exercises should be prepared as per the prescribed format.

Practical Examination should be based on viva-voce of the above work.

(MTM 673) SEMINAR – II**Teaching Scheme:**

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.

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

(MTM 731) DISSERTATION PART – I

Teaching Scheme:

Contact Hours: 12 hrs/week

Credit: 12

Examination Scheme:

Term Work: 50 Marks

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 literature 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.

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(MTM 781) DISSERTATION PART – II

Teaching Scheme:

Contact Hours: 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.