S Y L L A B U S

Master of Technology (M. Tech.)

MECHANICAL ENGINEERING

Specialization in

Production & Industrial Engineering
Thermal Engineering
Machine Design

(Effective from 2012-2013)

Department of Mechanical Engineering
Faculty of Engineering & Technology
Jamia Millia Islamia
New Delhi - 110025
INDIA
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From the desk of Professor Abid Haleem

Mechanical engineering is one of the most prominent branch in engineering, that contribute vitally in building the society in India. Its importance has been enhanced when it is taught at Post Graduate level, as Master of any course will leads the responsibility on their shoulders to move forward, and hence contribute more. The goals, activities, and contributions of Master in Technology, in Mechanical Engineering are very appealing to all the students who are interested in building their carrier in higher educations. As a step of nation building Jamia Millia Islamia, New Delhi, puts a step forward in starting Master in Mechanical Engineering with specialization in all three major areas and provide a thrust to the students of the community.

The design, development and compilation of this course structure and syllabus has been truly a collective effort. It has benefited from the inputs received from various subjects' experts in various forms, from professors, industrialists, researchers, and students. In compilation of this, we have tried to address most of the concern raised by the stakeholders, in doing so, we have tried to relate the mechanical engineering with realistic world problem that the society faces now a days. The syllabi are designed in such a way that they contain the latest book of the respective areas, and emphasizing on developing the research capability in the students.

It enhances the skill and employability of the student by proposing two audit courses in the curriculum viz. comprises English and Computer. The content of courses exposes to lab. and theory courses than other conventional M. Tech courses.

Numerous people have assisted in the development and compilation of this syllabus. Some provide help in direct and concrete manner while other provides help in less direct and more supportive ways. The Mechanical engineering department appreciated the hard work done all the faculty members concern in compiling the syllabi and sending their inputs, in materializing it. We also wish a special thanks to Prof. Sushil, Prof. S. G. Deshmukh, Prof. J P Subrmanium, and Prof. S M Yahya, IIT Delhi, New Delhi, and other persons outside the country Prof. Charles and Prof. M. Arif, University of Salford, for their valuable inputs.

Finally, I would like to thanks the faculty member of the Department of Mechanical Engineering and other friends, colleague, mentors, who have been supportive and instructive in a variety of diverse ways over a period of time. Special thanks are also due to Mr. M Asjad and Mr. Mohd Hassan for their assistance in processing and close coordination.

We take great pleasure in placing this course structure in the hand of students and teachers. As Jamia Millia Islamia is committed to the systemic reform and continuous improvement in the quality of its teaching, we welcomes comments and suggestions which will enable us to understand further refinement and enhancement of the syllabi according to the need of current scenario.

New Delhi
17 November 2012

Prof. Abid Haleem
Head Department of Mechanical Engineering
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Jamia Millia Islamia, New Delhi-110025

Contents

JAMIA MILLIA ISLAMIA

Introduction: Jamia Millia Islamia, an institution originally established at Aligarh in United Provinces, India in 1920 became a Central University by an act of the Indian Parliament in 1988. In Urdu language, Jamia means 'University', and Millia means 'National'.

The story of its growth from a small institution in the pre-independence India to a central university located in New Delhi—offering integrated education from nursery to research in specialized areas—is a saga of dedication, conviction and vision of a people who worked against all odds and saw it growing step by step. They "built up the Jamia Millia stone by stone and sacrifice by sacrifice," said Sarojini Naidu, the nightingale of India.

Conception: Under the colonial British rule, two dominant trends joined hands and contributed towards in the birth of Jamia. One was the anti-colonial Islamic activism and the other was the pro-independence aspiration of the politically radical section of western educated Indian Muslim intelligentsia. In the political climate of 1920, the two trends gravitated together with Mahatma Gandhi as a catalyst. The anti-colonial activism signified by the Khilafat and the pro-independence aspirations symbolised by the non-cooperation movement of the Indian National Congress helped to harness creative energies and the subsequent making of Jamia Millia Islamia. Rabindranath Tagore called it "one of the most progressive educational institutions of India".

Responding to Gandhiji's call to boycott all educational institutions supported or run by the colonial regime, a group of nationalist teachers and students quit Aligarh Muslim University, protesting against its pro-British inclinations. The prominent members of this movement were Maulana Mehmud Hasan, Maulana Mohamed Ali, Hakim Ajmal Khan, Dr. Mukhtar Ahmad Ansari, and Abdul Majid Khwaja.

Foundation: The Foundation Committee met on 29 October 1920. It comprised of the following members:

* Dr. Mukhtar Ahmad Ansari (Delhi)
* Mufti Kafayattullah (Delhi)
* Maulana Abdul Bari Farang Mahali (UP)
* Maulana Sulaiman Nadvi (Bihar)
* Maulana Shabbir Ahmed Usmani (UP)
* Maulana Husain Ahmad Madni (UP)
* Chaudhury Khaleeq-uz-zaman (UP)
* Nawab Mohammad Ismail Khan
* Tasadduq Husain Khan (UP)
* Dr. Mohammad Iqbal (Punjab)
* Maulana Sanaullah Khan Amritsari (Punjab)
* Dr. Saifuddin Kitchlew (Punjab)
* Maulana Abul Kalam Azad (Bengal and Bihar)
* Dr. Syed Mehmood (Bengal and Bihar)
* Saith Abdullah Haroon Karachiwale (Sindh, Bombay and Hyderabad)
* Abbas Tyabiji (Sindh, Bombay and Hyderabad)
* Sait Miyan Mohammad Haji Jaam Chhotani (Sindh, Bombay and Hyderabad)
* Maulavi Abdul Haq (Sindh, Bombay and Hyderabad)

On 22 November 1920, Hakim Ajmal Khan was elected the first chancellor of Jamia. Mohamed Ali Jauhar became Jamia's first Vice Chancellor, as Allama Iqbal could not accept the offer made through Gandhiji. It also elected a syndicate and created a syllabus subcommittee.

The known freedom fighter and Muslim theologian, Maulana Mehmud Hasan, laid the foundation stone of Jamia Millia Islamia at Aligarh on Friday, 29 October 1920. Considering the difficult circumstances under which it started, the list of its first teachers is very impressive:

Crisis: Born out of political crisis, it seemed for a while, Jamia would not survive the heat of the intense political struggle for the independence of India. It participated in the Bardoli resolution and sent volunteers across the country to motivate people to fight for the freedom of the country. The colonial British government soon imprisoned many of its teachers and students. In 1922, Gandhiji called off the non-cooperation movement. Even as its teachers and students were being released, Mustapha Kemal Ataturk declared the end of the Khilafat in 1924.

Suddenly Jamia saw itself in a great crisis. Some thought it had achieved its mission, as others believed that the institution had lost its raison d'etre with the end of the non-cooperation and the Khilafat movements. Even the little financial assistance, that the Khilafat had been giving it, also dried up. As even prominent people started deserting it, Jamia's total collapse virtually became an imminent possibility.

Jamia Moves to Delhi: The saying, 'when going gets tough the tough gets going' cannot be truer about Jamia. As the crisis loomed large, Hakim Ajmal Khan, Dr. Mukhtar Ahmed Ansari and Abdul Majeed Khwaja—the first trio—supported by Gandhiji shifted Jamia from Aligarh to Karol Bagh, in New Delhi in 1925. Gandhiji boosted the morale of Jamia, saying, "The Jamia has to run. If you are worried about its finances, I will go about with a begging bowl". Jamia followed Gandhiji's constructive programme for self-reliance while it took to Charkha and Takli as favoured vocations.

Although Gandhi's contacts helped to secure financial help for Jamia, the risk of helping a Congress-backed institution under the British Raj dissuaded many willing benefactors. Orthodox Muslims also viewed Jamia as a threat to Aligarh Muslim University, the 'Muslim Oxford'. During those difficult days, it was Hakim Ajmal Khan who met most of Jamia's expenses from his own pocket. Dr. M.A. Ansari and Abdul Majeed Khwaja toured India and abroad, explaining the importance of Jamia and collecting funds for this noble enterprise. Their collective intervention did avert a collapse that was almost certain.

Resurgence: The Second Trio: In 1925, after long deliberation, a group of three friends studying in Germany—Dr. Zakir Husain, Dr. Abid Husain and Dr. Mohammad Mujeeb—decided to serve Jamia. Dr. Zakir Husain, who had earned his doctorate in Economics from the University of Berlin, was a natural and charismatic leader. Dr. Abid Husain had his Ph.D. in Education. Mohammad Mujeeb, an Oxford scholar in History and a student of printing in Germany, was a passionate and committed reformist. Early in February 1926, the three friends left Germany for Jamia by the Norddeutscher Lloyd steamer, SS Derfflinger.

In Jamia, Dr. Zakir Husain, was offered a salary of Rs. 100. His two other friends with European qualifications were offered Rs 300 each. Realising that the possibility of making payments was beyond Jamia's limited resources, Abid Husain and Mohammad Mujeeb voluntarily reduced their salaries to Rs. 100 each. Moved by the commitment of his friends, Dr. Zakir Husain also reduced his own salary to

Rs. 80. One of the first steps they took was the introduction of the hugely popular evening classes for adult education. This movement was later to become, in October 1938, an institution called *Idara-i-Taleem-o-Taraqqi*. It kept growing so popular that separate rooms had to be built to accommodate the students.

In 1928 Hakim Ajmal Khan passed away. That was the beginning of the second financial crisis, as it was Hakim Sahib himself who had been meeting most of Jamia's financial needs. The leadership of Jamia then moved into the hands of Dr. Zakir Husain, who became its Vice Chancellor in 1928. To resolve Jamia of these frequent crises, a group of young Jamia teachers, led by Dr. Zakir Husain, took a pledge to serve Jamia for the next twenty years on a salary not more than Rs. 150. This group was called the Life Members of Jamia. (History repeated in 1942 when a second group of Jamia teachers took a similar pledge).

Jamia's department of Printing and Publications was trifurcated in 1928 with the newly established Jamia Press at Darya Ganj, Urdu Academy, and Maktaba Jamia under the charge of Prof. Mohammad Mujeeb, Dr. Abid Husain and Mr. Hamid Ali respectively.

Shifting to the New Campus: On 1 March 1935, the foundation stone for a school building was laid at Okhla, then a non-descript village in the southern outskirts of Delhi. In 1936, all institutions of Jamia, except Jamia Press, the Maktaba and the library, were shifted to the new campus. The basic emphasis of Jamia was on evolving innovative education methods. This led to the establishment of a teacher's college (Ustadon ka Madrasa) in 1938. In 1936, Dr. M.A. Ansari passed away. On 4 June 1939, Jamia Millia Islamia was registered as a society.

The fame of Jamia as an innovative education movement spread and dignitaries from foreign countries began visiting Jamia. Husein Raouf Bey (1933), Dr. Behadjet Wahbi of Cairo (1934), Ms. Halide Edib of Turkey (1936) were some of them. Foreigners, impressed by Jamia, began working in Jamia. The German lady Ms. Gerda Philipsborn (popularly known as Aapa Jaan) served Jamia for many years is buried in Jamia.

In 1939, Maulana Ubaidullah Sindhi (1872-1944), a theologian and freedom fighter, came to stay in Jamia on the invitation of Dr. Zakir Husain. He started a school of Islamic Studies in Jamia, called Baitul Hikmal, propagating the ideology of Shah Waliullah. Zakir Husain, later the President of India, recalled those days of indestructible optimism in the face of depravity 'when they had a longing to build and nothing to build with, as "days of joy".

In 1946, during Jamia's silver jubilee celebration, one could see the crisis that India had to face in the following year: Mr. and Mrs. Mohammad Ali Jinnah, and Liyaqat Ali Khan were on one side of Dr. Zakir Husain, the vice chancellor, on the dias; Pandit Jawaharlal Nehru, Asaf Ali and Sir C Rajagolapachari were on the other side.

Independence and After: The riots following partition that shook the northern India did affect Jamia; but not its campus. Gandhi observed that its campus remained "an oasis of peace in the Sahara" of communal violence. Maktaba Jamia alone lost books worth seven lakhs in arson.

After the attainment of Independence, Jamia continued to grow as an academic institution with a difference. Many foreign dignitaries made it a point to visit Jamia Millia Islamia during their visits to New Delhi.

Among those who visited Jamia include Marshal Tito (1954), king Zahir Shah of Afghanistan (1955), crown prince Faisal of Saudi Arabia, king Reza Shah Pehlavi of Iran (1956) and prince Mukarram Jah (1960).

Following the death of Mr. Abdul Majeed Khwaja in 1962, Dr. Zakir Husain, who by then had taken charge as the Vice President of India, became Jamia's Chancellor (1963).

Deemed to be University: In 1962, the University Grants Commission declared the Jamia a 'deemed to be University'. Soon thereafter, the School of Social Work was established in 1967. In 1971, Jamia started the Zakir Husain Institute of Islamic Studies, to honour Dr. Zakir Husain, who had passed away in 1969. BE course in Civil Engineering commenced in 1978; in 1981, the faculties of Humanities and Languages, Natural Sciences, Social Science, and the State Resource Centre were founded. In 1983, it started the Mass Communication Research Centre and the Centre for Coaching and Career Planning. In 1985, it established the Faculty of Engineering & Technology and the University Computer Centre. Academic Staff College and the Academy of Third World Studies followed in 1987 and 1988.

Central University: By a Special Act of the Parliament, Jamia Millia Islamia was made a central university of India in December 1988. In the list of the Faculties, i.e. Education, Humanities & Languages, Natural Sciences, Social Sciences. Engineering & Technology, one more Faculty - Faculty of Law, was added in 1989. Many new courses and programmes at UG and PG levels have since been added.

Besides its Nine faculties, the Jamia has a number of centres of learning and research, like AJK-Mass Communication Research Centre (MCRC), Academy of International Studies etc. The Jamia is also marching ahead in the field of Information Technology (IT). It offers various undergraduate and postgraduate IT courses. Apart from this, the Jamia has a campus wide network which connects a large number of its departments and offices.

DEPARTMENT OF MECHANICAL ENGINEERING

The Faculty of Engineering and Technology developed an environment of Technology at the Jamia Millia Islamia, New Delhi. It is a leading and dynamic faculty that is one of the foremost providers of high-level technical education and research in the university. The Faculty is renowned for its unique approach to innovations and, its status and links with the industry.

The Department of Mechanical Engineering, Faculty of Engineering and Technology at Jamia Millia Islamia is to provide students with a sound mechanical engineering education, enhance the understanding and application of mechanical engineering principles, for techno economical development of the country, and improve the quality of life of our citizens through teaching, research, and outreach programs. The mission is further to provide an environment where students have extensive avenues to excel, improve technical exposure and develop personality and then get placed in PSUs, MNCs and reputed companies with good future so that students have global presence, in various roles and responsibilities. With excellent teaching and learning environment it provides a platform to instill high motivation, moral values and leadership in its students.

The Department offers eight-semester Bachelor of Technology (B.Tech.) course with an annual intake of seventy, four-semester Master of Technology (M. Tech.) course with annual intake of 18 and Doctor of Philosophy (Ph.D.) in Mechanical Engineering. M. Tech. Program is offered in three broad areas of Mechanical Engineering namely Production-Industrial Engineering, Machine Design and Thermal Engineering. The department has a student population of about 560 at UG, 40 at PG and about 44 at doctoral research levels. In addition, it also offers four-year, Bachelor of Engineering (B.E) (Part-Time) program in the evening with an annual intake of 70 for working diploma holders to up-grade their knowledge and skill.

The students from diverse background are selected through a nationwide written test followed by an interview. The posh campus, situated in southern suburb of national capital provides excellent teaching and learning environment to the students. Most of the classrooms are fitted with modern audio visual aids. The undergraduate curriculum of the Department includes a foundation of mathematics, physics, chemistry, environment, humanities, and electrical engineering. Engineering courses in fundamental areas constitute much of the remaining curriculum. A few technical electives allow the undergraduate student to specialize somewhat or to pursue broader understanding. In addition, the students develop experiment conducting skill by performing experiments in 20 different laboratories in the department. Department also supports workshop to students of all branches of Engineering.

The course curriculum has been designed to prepare its graduates to become intellectual leaders in industry, government, and academia. Graduates of the program will have the professional and scientific knowledge that allows them to be successful as career engineers and in the most demanding graduate programs. Specifically, they will be able to:

- Function in professional environments in industry, government, and academia applying and building upon engineering science knowledge, problem-solving skills, and communication skills;
- Function as members of teams and in leadership roles applying ethical standards beyond traditional Mechanical engineering disciplines; Remain acquainted with technology and contemporary scientific and societal issues, and consequently improve skills and knowledge through a lifelong process of learning.
- Good research facilities and teaching oriented laboratories are available in Metrology, Ergonomics, CAD, Computer Integrated Manufacturing and Refrigeration and Air-conditioning

Department has active and vibrant students' chapters of major professional bodies as American Society of Mechanical Engineers (ASME) and Society of Automotive Engineers (SAE). Here they get a world class platform for organizing, participating and developing engineering ideas. This helps them in developing a holistic personality.

The Department commitment to quality education makes it one of the top research place in the world and one of the foremost providers of high-level intellectual capital. Its excellent staff, comprising of 24 world class academic staff members and 22 efficient members of the support staff and facilities that include sophisticated experimental and computer laboratories have enabled the Department to establish various internationally renowned centers of excellence. Facilities include the following:

- Unique laboratories for CAD/CAM lab, Metrology, Refrigeration and Air Conditioning, etc. which are important for mechanical engineering education
- A superbly equipped vibration and controls laboratory

The Department derives its excellence from the team of highly qualified, experienced, sincere and dedicated teaching faculty members, all employed have PhDs, except few members pursuing research. The Faculty members actively participate in research and consultancy-work with a gross departmental publication of exceeding 500 in reputed refereed International Journals.

Research in the Department of Mechanical Engineering is diverse and scholars are directly exposed to the multidisciplinary nature of modern mechanical engineering and its allied areas. At any point of time approximate 40 students are enrolled in the department for research. The Department provides facilities and supervision to conduct research on advanced topics of Industrial-Production, Thermal and Machine Design Engineering.

The Department has active collaboration with academics and industry such as University of Salford (UK), CII, IIT Delhi, NTPC, TERI, DTU, DST, DRDO, currently department is undertaking two sponsored research projects one from Department of Science and Technology for Rs 15.36 Lacs (on Technology Forecasting and Assessment) and another from Ministry of Environment and Forests partnered with TERI for Rs 68 Lacs.

In the past, several events including International conferences, National conferences, Summer schools, Seminars and Workshops related to various areas of Mechanical Engineering have been organized and similar events are planned to be organized in future too.

List of Faculy Members

S.No	Name	Qualifications	Specialization
1	Prof. Abid Haleem (Head)	Ph.D	Industrial Engineering
2	Prof. I. A. Khan	Ph.D	Machine Design
4	Prof. Mohd. Islam	Ph.D	Thermal Engineering
5	Prof. Mukhtar Ahmed	Ph.D	Fluid Mechanics
6	Prof. M. Emran Khan	Ph.D	Thermal Engineering
7	Prof. M. M. Hasan	Ph.D	Thermal Engineering
8	Mr. Iqbal Azam**	M.Sc. Engg.	Machine Design
9	Prof. Z. A. Khan	Ph.D	Industrial & Production Engg.
10	Prof. Zulqurnain Mallick	Ph.D	Industrial & Production Engg.
11	Prof. Mohd. Suhaib	Ph.D	Machine Design
12	Dr. J. A. Usmani	Ph.D	Thermal Engineering
13	Mrs. Haleema Begum	M.Tech	Machine Design
14	Dr. M. N. Karimi	Ph.D	Thermal Engineering
15	Mr. Arshad Noor Siddiqui	M.Tech	Production Engineering
16	Dr. Abdur Rahim	Ph.D	Fluid Mechanics
17	Mr. S.M. Muzakkir	M.Tech	Machine Design
18	Dr. Aas Mohammad	Ph.D	Machine Design
19	Mr. Lokesh Kumar	M.Tech	Production Engineering
20	Dr. Islam Nawaz	Ph.D	Thermal Engineering
21	Dr. Sabah Khan	Ph.D	Machine Design
22	Dr. Ali Hasan	Ph.D	Machine Design
23	Mr. Mohammad Asjad	M.Tech	Industrial Engineering
24	Mr. Ahmad Faizan Sherwani	M.Tech	Thermal Engineering

*** Principal University Polytechnic, Functioning as Professor Till Further Orders, w.e.f 2/2/2010*

COURSE STRUCTURE

M. Tech. in Mechanical Engineering

(Specialization in Industrial & Production Engineering,Thermal Engineering and Machine Design)

First Semester

COURSE NO.	COURSE TITLE	CREDITS	PERIOD PER WEEK			MARKS		
			L	T	P	SESSIONAL	THEORY	PRACTICAL
MTC-101	Advanced Mathematics	4	3	1	-	40	60	-
MTC-102	Optimization Methods	4	3	1	-	40	60	-
	Program Core-I	4	3	1	-	40	60	-
	Program Core-II	4	3	1	-	40	60	-
	Program Elective-I	4	3	1	-	40	60	-
	Lab I	2	-	-	4	30	-	20
MTC-103	Compulsory audit course in Computer Programming (LC)*		-	-	4	30		20
*(LC): Lab. Course			**15**	**5**	**8**	**260**	**300**	**40**
Total Credits 22		**Total periods / week = 28**					**Total Marks = 600**	

Second Semester

COURSE NO.	COURSE TITLE	CREDITS	PERIOD PER WEEK			MARKS		
			L	T	P	SESSIONAL	THEORY	PRACTICAL
MTC-201	Finite Element Methods	4	3	1	-	40	60	-
MTC-202	Statistics for Decision Making	4	3	1	-	40	60	-
	Program Core-III	4	3	1	-	40	60	-
	Program Core-IV	4	3	1	-	40	60	-
	Program Elective-II	4	3	1	-	40	60	-
	Lab II	2	-	-	4	30	-	20
MTC-203	Compulsory audit course in Technical Communication (TC)*		2			20	30	
* (TC): Theory Course			**17**	**5**	**4**	**250**	**330**	**20**
Total Credits = 22		**Total periods / week = 26**					**Total Marks = 600**	

Course structure approved by B.O.S on October 18, 2011 and confirmed on December, 1 2011
(With effect from session 2012-13) also approved by Academic Council on July 26, 2012

COURSE STRUCTURE

M. Tech. in Mechanical Engineering

(Specialization in Industrial & Production Engineering,Thermal Engineering and Machine Design)

Third Semester

COURSE NO.	COURSE TITLE	CREDITS	PERIOD PER WEEK			MARKS		
			L	T	P	SESSIONAL	THEORY	PRACTICAL
	Program Elective III	4	3	1	-	40	60	-
	Program Elective IV	4	3	1	-	40	60	-
MTC-301	Project	4	-	-	8	60	-	40
MTC-302	Seminar	2			4	30		20
			6	**2**	**12**	**170**	**120**	**60**
Total Credits = 14		**Total periods / week = 20**						**Total Marks = 350**

Fourth Semester

COURSE NO.	COURSE TITLE	CREDITS	PERIOD PER WEEK			MARKS		
			L	T	P	SESSIONAL	THEORY	PRACTICAL
MTC-401	Dissertation	12	-	-	24	180	-	120
					24	**180**		**120**
Total Credits = 12		**Total periods / week = 24**						**Total Marks = 300**

Note:

1. Students have to study 4 Program Core Course from their respective specialization. (Program Core will be decided by the Department)
2. Program Elective-I to Program Elective-IV and Lab-I & Lab-II shall be offered by the respective stream (area of specialization) i.e. Industrial & Production Engineering /Thermal Engineering /Machine Design. However, student has the flexibility to opt for 4 Program Electives either from his specialization or other specialization and/or from other engineering department of the faculty; and they would be called as Program electives. This will be decided by the Department.
3. Audit Course of Computer Programming is a compulsory lab course of 2 credits in first semester.
4. Audit course of Technical Communication is a compulsory theory course of 2 credits in second semester.
5. The credits of an audit course will not be counted towards the credits for the degree completion requirements. Passing of audit course is mandatory for obtaining M. Tech Degree. Thus, Credit earned in these audit courses will not be considered for the computation of SGPA/CGPA.
6. Total credit required for passing M.Tech.is 70.
7. Total marks required for M.Tech.is 1750

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M.Tech in Mechanical Engineering

Common Courses

MTC-101	Advanced Mathematics	MTC-102	Optimization Methods
MTC-201	Finite Element Methods	MTC-202	Statistics for Decision Making
MTC-303	Project	MTC-304	Seminar/Lab
MTC-401	Dissertation		

Compulsory Audit Courses

MTC-103	Computer Programming	MTC-203	Technical Communication

Industrial and Production Engineering

Program Core and Elective Courses

MTI-101	Operations Management	MTP-101	Computer Integrated Manufacturing
MTI-102	Creative Problem Solving	MTP-102	Modern Manufacturing Methods
MTI-103	Design of Experiments	MTP-103	Foundry Technology
MTI-104	Project Management	MTP-104	Tool Design
MTI-105	Total Quality Management	MTP-105	Metrology
MTI-106	Supply Chain Management	MTP-106	Welding Technology
MTI-107	Management Inf. System	MTP-107	Advanced Material Science
MTI-108	Human Factor Engineering		
MTI-109	Reliability Engineering		
MTI-110	Knowledge Management		

Thermal Engineering

Program Core and Elective Courses

MTT-101	Advanced Heat and Mass Transfer	MTT-102	Advanced Fluid Mechanics
MTT-103	Advanced Thermodynamics	MTT-104	Turbo-Machinery
MTT-105	I.C Engines and Air Pollution	MTT-106	Conventional & Non-conventional Energy Sources
MTT-107	Utility Engineering	MTT-108	Gas Dynamics
MTT-109	Land Fill Gas: from Environment to Energy		

Machine Design

Program Core and Elective Courses

MTD-101	Theoretical and Exp. Stress Analysis	MTD-102	Advanced Mechanisms
MTD-103	Advanced Mechanical Engg. Design	MTD-104	Vibration Engineering
MTD-105	Tribological Systems Design	MTD-106	Robotics
MTD-107	Mechatronics	MTD-108	Concurrent Engineering

COMMON COURSES

MTC – 101
ADVANCED MATHEMATICS

Contact hours/semester: 50 **L-3:T-1:P-0**

This course is structured in order to provide insight knowledge about the application of mathematics in engineering practices.

UNIT - I

Applications of Laplace transforms and I.L.T. in the particular solution of integral equations and integro-differential equations, Z-transforms and its applications in the solution of linear difference equations, Use of DeMoiver's theorem, Ferrari/Descarte method, Cardan's method, reciprocal-equation method in the general solution of higher order ordinary linear differential equations with constant and variable coefficients, Use of Euler-Poisson equations in Calculus of Variations (i.e. external of functional), Isoperimetric problems.

UNIT - II

Infinite Fourier transforms, infinite Fourier sine and cosine transforms and its applications, Fourier-Legendre series, Fourier-Bessel series, Product solutions of Laplace equations, heat conduction equations, wave equations, Poisson's equations by the method of separation of variables and its applications in boundary value problems, General solution of homogeneous and non-homogeneous linear partial differential equations of higher order with constant and variable coefficients.

UNIT - III

Envelope of a family of curves, Evolute of a curve, Geometrical representation of W = f (z), Conformal mapping, Problems on Tensor analysis, Properties of eigen values of square matrices of order 4, 5 and 6, and complex matrices, Numerical solution of boundary value problems using finite difference and cubic spline methods, Numerical solution of heat conduction equations, Poisson, Laplace and wave equations.

UNIT - IV

Interpolation, Aitken and Aitken-Neville methods, Missing-terms problems, Hermite Interpolation, Fitting of a curve in given sub-interval using cubic spline interpolation, Representation of a tabulated function in powers of (x –a) using Newton's divided difference formula, Applications of numerical successive differentiation in practical problems and double interpolation.

UNIT - V

Numerical integration using Romberg method, Gauss-Legendre and Lobatto methods, Gaussian integration and numerical double integration; Conversion of a differential equation into integral equation and vice versa, Solutioins of Fredholm and Volterra integral equations of first and second kinds; Numerical solution of a system of non-linear equations using Newton-Raphson method; Solution of system of linear equations in four variables using Gauss-Jorden and Crout's methods.

Recommended / Reference Books:

1. Advanced Engineering Mathematics, by Erwin Kreyszig, Wiley Eastern India Ltd.
2. Higher Engineering Mathematics, by B.S. Grewal, Khanna Publishers.
3. Introductory Methods of Numerical Analysis, S.S. Sastry, 3rd edition, Prentice Hall of India (PHI)
4. Numerical Methods for Scientific and Engineering Computation, by Jain, Iyengar and Jain, 4th edition, New Age International Pvt.Ltd.
5. Advanced Engineering Mathematics, by Jain, Iyengar and Jain, 4th edition, New age International Pvt.Ltd.

MTC – 102
OPTIMIZATION METHODS

Contact hours/semester: 50 **L-3:T-1:P-0**

The course is designed in order to provide the knowledge of various problem solving technique in context to engineering application

UNIT-I
Introduction to optimization, Historical development, engineering application of optimization, Formulation of design problems as mathematical programming problems, Classification of optimization problems, introduction to Stochastic and deterministic Algorithms.

UNIT-II
Linear Programming, Graphical method, Simplex method, Duality in linear programming, post-optimality analysis, LP for multi period decision process, application of LP to environmental engineering problems, Use of Spreadsheets for solving LP problems. Software application. (LINDO & LINGO)

UNIT-III
Non Linear Programming, single-variable and multi-variable unconstrained optimization techniques, Direct search methods, Descent methods, Constrained optimization, Multivariable optimization with equality and inequality constraints. Direct and indirect methods, Kuhn-Tucker conditions for constrained optimization. MATLAB Applications for solving NLPP

UNIT-IV
Dynamic Programming, characteristics of dynamic programming problems, computational procedure, multi-decision processes, concept of sub optimization and the principle of optimality, discrete differential dynamic programming, application of DP to Mechanical Engineering problems.

UNIT-V
Introduction to Artificial Intelligence techniques, Introduction to Genetic Algorithm, Real value representation, Approaches to crossover schemes, Variations of Mutation Scheme, Simulated Annealing. Case study and Problem solving through software.

Recommended / Reference Books:

1. G. Haddley, Linear Programming, Reading, Mass., Addison-Wesley, 1962
2. Hillier, F. S., and G. J. Lieberman, "Introduction to Operations Research, McGraw Hill, 2001
3. R. L. Fox, Optimisation Methods for Engineering Design, Addison Wesley USA, 1971
4. Deb, K. Optimisation for EngineeringDesign, Prentice Hall of India, 2000
5. S. S. Rao, Optimisation Theory and Applications, Wiley Eastern, New Delhi, 1978
6. Taha Hamdy, Operations Research, Pearson, USA

Software required: LINDO & LINGO, Matlab, MAPLE

MTC – 103
COMPUTER APPLICATIONS

Contact hours/semester: 28 **L-3:T-1:P-0**

This subject deals with the essential computer applications needed for improving individual productivity. Starting from power point presentation, spread sheet processing to database management, this subject proceeds to the basics of programming language. Many packaged software comes with coding interface for advanced applications. So knowledge of programming logic becomes very handy. And you don't remain aloof to it. At the end of the course we will write some interesting computer programs.

UNIT I: MS Power Point

Introduction: Elements of power point package- templates, wizards, views, color schemes, Starting PowerPoint, Exploring PowerPoint menus, Starting a new slide, Adding title, text and art, Moving text area and resizing text box, Starting a slide show, Saving a presentation, Printing slides, Inserting and deleting slides, Closing a presentation, Exercise for making a presentation and slide show

Views: PowerPoint views – slide view, outline view, slide sorter view, notes view, slide, show view, slide setup, Zoom in, zoom out, Exercises on various views of presentation

Formatting and Enhancing text: Formatting, Changing format with a new layout, Alignment of text and text spacing, Enhancing text formatting – use of bullets, changing text font and size, Selecting text style and color, Applying design template, Closing and applying the transition, Spell checking, To set header and footer, Exercise on formatting text and applying design template.

Slide with graphs: Creating a graph, Adding graphic objects, Adding clipart pictures, Adding movies and sounds, Adding multimedia to presentation, Inserting excel worksheet or word table, Exercise on inserting graphs, tables, movies and clipart.

UNIT II: MS Excel

Formatting: Naming cell range, using automatic and conditional cell formatting.

Data Handling: Import data from other applications, use one and two input data and what-if tables. Sort and query data using single and multiple criteria. Use pivot tables and Dynamic crosstabs

Display: Freeze data headings, hide rows, columns and worksheets

Security: Protect worksheets or cells, password protect

Linking Data: Link data in worksheets and between worksheets and other applications, Consolidate data across worksheets

Charts & Graphs: Create charts and graphs and adjust presentation

Functions & Macros: Use a range of functions including text, statistical and lookup functions, Record and run macros.

UNIT III: MS Access

Introduction to Microsoft access: Components of access

Table creating: Starting access, creating tables, tool bars and views of tables, Editing the design and contents of the table, Creating relationship between tables, Adding OLE objects to a table, Use of import and export facility, Exercise on table creating

Query Handling: Creating a new query, use of criteria, expressions and operation, Editing a query, print a query, Exercise on creating and editing query

Form designing: Introduction, creating a form, modify a form design, designing a form using design view, Sub – forms, printing the forms, exercise on form designing.

Report designing: Creating a report, managing the different controls of the records, saving and printing the report, use of graphs in reports, Exercise on report designing.

UNIT VI: Programming Fundamentals

Algorithm, pseudo language, flow charts: advantages and disadvantages, Decision table – type, advantages and disadvantages, Structured programming: structuring the control flow, modular programming, Exercise on making algorithm and flow charts.

UNIT V: C++ Programming

Fundamentals: Introduction, oop, character set, C++ tokens, keywords, identifiers, constants, basic data type, declaration of variables, defining symbolic constants, assignment statement, comments in a programme, structure of C++ programme, output using COUT, output using CIN, manipulators.

Operators and Expressions: Arithmetic operators, relational operators, logical operators, shorthand assignment, operator, increment and decrement operators, conditional operators, bit wise, operators, precedence in C++ operators, casting of data, standard mathematical functions.

Control structures: IF statements, IF—ELSE statements, nested IF statements, switch statements, Go To statements, repetitive structures, while statements, do statement, for loop, break statement, continue statement, nested loops.

Programs:

Write a program to check if a number is even or odd.

Write a program to find the smallest of 3 numbers.

Write a program to find largest of 4 numbers

Write a program to find the roots of quadratic equation.

Write a program to find the sum of the first N natural numbers using a for – do loops.

Write a program that reads in N numbers and finds the smallest number among them.

Write a program to find the sum of squares of the digits of a number.

Recommended / Reference Books:

1. MS Office 2000 by Steve Hill; BPB Publications.
2. Programming in C++ by B. Subharamanayam.

MTC – 201
FINITE ELEMENT METHODS

Contact hours/semester: 50 **L-3:T-1:P-0**

To understand the fundamental ideas of the FEM to be able to prepare a suitable FE model for structural mechanical analysis problems and can further interpret and evaluate the quality of the results (know the physics of the problems)

UNIT - I

Introduction of Fem & Concepts: Objective of the course, Basic steps in FEM. Descretisation, Formulation, Assembly, Solution, Boundary conditions, Elements, nodes and degree of freedom. Element characteristic matrix. Different methods to derive an element characteristic matrix. Direct method to develop element stiffness matrix. Types of elements, one-dimensional elements, two-dimensional elements and their classification. Three-dimensional elements. Related problems.

UNIT - II

Interpolation or Shape Functions: Isoparametric concepts. Shape functions of one dimensional element,. Linear, Quadratic, cubic and quadric bar elements, shape functions of two-dimensional elements (Lagrangian and Serendipity family), shape functions of triangular elements, Derivative of shape. functions, Jacobian matrix [J], [J] matrix for bar elements, and 2 dimensional elements, Numerical Integration using FEM, Gaussian Integration method, order of integration, Double integration, Redean Integration. Related problems.

UNIT - III

Analysis of Plane Truss And Heat Transfer Using FEML: Solution of the plane truss, Deriving element stiffness matrix (Truss Element) [k], Global stiffness matrix [K] and its physical meaning, Properties of [K] matrix. Solution of unknowns. Simple problem of truss having 3 bars, Application of FEM in Heat transfer, Heat transfer through conduction, convection and radiation.

UNIT - IV

Application of FEM in Solid Mechanics: Differential equations of equilibrium, Canoh's equations at the boundary, Strain and displacements relation, Gradient matrix [B], Nodal displacements matrix {Ô}, strain and stress matrix, Partial Integration, Green-Gause theorem, Potential energy approach, Weighted Residual Procedure, Galarkin method, One dimensional problem, two dimensional problem (Beam analysis), Axisymmetric problems,

UNIT - V

Application of Fem in The Beam And Vibration Analysis:

Beam: Hermition shape function, stiffness matrix for beam and Related problems.

Vibrations: Structural dynamics, mass matrix consistence mass matrix, natural frequency, mode shapes with simple examples.

Recommended / Reference Books:

1. Chandupalta, 'FEM', Prentice Hall of India.
2. Rajshekhram, 'Finite Element Methods,' Wheeler Publisher.
3. S. S. Rao, 'Finite Element Methods', Pergamon Press.
4. Cook, Malkus & E. Plesha, 'Concepts and applications of FEA, John Wiley & Sons.

Software required: ANSIS, NASTRAN, MATLAB

MTC – 202
STATISTICS FOR DECISION MAKING

Contact hours/semester: 50 **L-3:T-1:P-0**

This course has been designed to provide the basic knowledge of statistics and its subsequent application to engineering problems to arrive at meaningful decision.

UNIT - I

Deciphering the functions: Collecting data- Reducing large volumes of data by sampling, Comparing your collection against the population; Extracting information from data- Determining central tendency using various methods e.g.- Mean, Median, Mode, Mid-range, Calculating spread of data, Range, Variance, Standard Deviation and Ensuring confidence and accuracy. Designing graphs: Summarizing data visually, applying the appropriate graph type to simplify presentation.

UNIT - II

Distribution of the data: Sampling and Sampling Distributions, Inference: Interval Estimation, Hypothesis Testing about the Mean & Proportion of Single Populations. Modeling data with bell curves, Dividing data into percentiles, Identifying outliers, Hypothesis Testing about the Mean & Proportion of Two Populations, Chi-Square Tests of Goodness-of-fit & Independence, Simple Regression and Correlation and Analysis, Multiple Regression Analysis and Correlations Analysis Applying analysis of variance (AN OVA) to decision making.

UNIT - III

Assessing Risks,Assigning probability: Probability: Concepts, Theorems, & Rules, Discrete Probability Distribution - (Binomial only), Continuous Probability Distributions (Uniform & Normal), Determining the odds of success or failure, Building a frequency matrix to illustrate possibilities, Identifying scenarios that affect outcomes, Calculating probability based on a chain of events, Minimizing risks: Interpreting the level of risks within your project, justifying decisions based on calculation of probability

UNIT - IV

Theory of game. 2 (two) person zero sum game, minimax and maxmin strategies, solution of games by dominance rules, Basic techniques for solving stochastic linear and non-linear programming problems.

UNIT - V

Resolving problems with statistical solutions. Computer based statistical analysis. Project on case preparation.

Recommended / Reference Books:

1. Statistics for Business and Economics, by James 1. McClave, P. George Benson, and Terry Sincich, Tenth Edition, Prentice Hall. 2008. A student solutions manual is packaged with the text.
2. David Ivi. Levinef Timothy C Krehbiel / Mark L. Berenson. “Business Statistics”. 2nd Ed.Person Education Asia.
3. Richard, L Levin and David S. Ruben, (2003), “Statistics for Management” Hal! of India Pvt. Ltd., New Delhi
4. Hoel, Paul Gl ‘Statistics as applied to Business and Economics’ Wiley, New York.

Software required: MINITAB, SPSS

MTC – 203
TECHNICAL COMMUNICATION

Contact hours/semester: 28 **L-3:T-1:P-0**

This subject deals with technical writing, considered to be very valuable skill today. It adds a new dimension to the career, irrespective of working in any capacity. And today it is itself a rewarding career. We will have class discussions on the textbook which is very through and well researched on the subject. You will be required to write one formal report as well.

UNIT I: Scope of Technical Writing

1. What Is Technical Writing? - Attributes of Technical Writing, Other Types of Writing
2. Reasons for Writing - Excuses for Not Writing, Benefits of Technical Writing
3. Performing Technical Studies - Types of Technical Studies, General Methodology

UNIT II: Strategy, Options and Criteria for Technical Writing

1. Writing Strategy - Analysis of Readers, Scope of Writing, Purpose and Objective, Writing to various Readers
2. Document Options - Document Hierarchy, Report Types and Selection
3. Criteria for Good Technical Writing - Technical Content, Presentation, Language Skills

UNIT III: Style and Illustrations of Technical Writing

1. Writing Style - Elements of Style, Examples of Writing Styles, Recommended Style.
2. Using Illustrations - Reasons for Using Illustrations, How to Prepare Effective Illustrations, Captions for Illustrations, Referring to Illustrations.

UNIT IV: Formal and Informal Reports

1. Formal Reports: The Outline and Introduction – Outline, Title, Front Matter, Writing the Introduction, Putting It Together
2. Formal Reports: Writing the Body - Writing a Procedure, Describing Machines/Processes, Writing Test Results, Writing the Discussion Section
3. Formal Reports: Closure – Conclusions, Recommendations, References, Writing an Abstract, Back Matter, Report Distribution, Saving Reports
4. Informal Reports - Elements of an Informal Report, Investigation Reports, Service Work, Action Letters, Proposals

UNIT V: Review, Presentation and Effectiveness Measurement

1. Review and Editing - Types of Review and Edit, Reviews, Edits, Review and Editing Methodology, Examples of Reviews
2. Oral Presentations - Types of Oral Presentations, Preparation, Visual Aids, Presentation
3. Getting It Done - Impediments to Writing, Maintaining Writing Skills, Measuring Report Results

UNIT VI: Types of Reports and Their requirements:

Summer Training report, M Tech Project Report Technical Paper for a journal/conference

Recommended / Reference Books:

1. Kenneth G. Budinski, Engineer's Guide to Technical Writing, ASM International, 2001.

INDUSTRIAL AND PRODUCTION ENGINEERING

MTI – 101
OPERATIONS MANAGEMENT

Contact hours/semester: 50 **L-3:T-1:P-0**

This course is designed to acquaint the students with decision making in planning, scheduling and control of Production / Operation function and the effective acquisition, storage and flow of material in both manufacturing and service organization so as to achieve total productivity.

UNIT - I

Introduction to Operations Management: Operation, function and systems view; Managing the operation subsystem; Financial and economic analysis. Layout planning:
Concepts, models and applications; Designing products, services and processes: Product design, Product and Process life cycle, Product design tools, Product design for services, Environmental issues.

UNIT - II

Operations scheduling: Intermittent systems, Loading, Sequencing and Input output Control; Manufacturing process technology; (flow process, job shop process, cellular processes); Modern production technologies: CAD/CAM, FMS, and CIM.
Job design: Method, analysis and improvement; Operation standards and work measurement; Maintenance management, Value analysis approach.

UNIT - III

Project management with CPM and PERT, Operation planning and scheduling systems, aggregate planning process with strategies for production and service organization. Master scheduling: Implementation and behavioural considerations.

UNIT - IV

Inventory Management, Material Requirement Planning (MRP), Just in Time Systems, Supply Chain Management and Critical Chain.

UNIT - V

Quality: concepts, quality assurance and control, Quality Systems (ISO-9000), Cost of quality, Tools and techniques in quality, Statistical process control, Control charts, Capability analysis, Acceptance sampling plans, reliability, Concepts of TQM.

Recommended / Reference Books:

1. Krajewski Lee J and Ritz man Larr P, (2000), "Operations Management-Strategy and Analysis," Addison Wesley Longman, New Delhi.
2. Martinich, Joseph S, (2002), "Production and Operations Management: An Applied Modern Approach," John Wiley, Re. Ed.
3. Dilworth, James B, (1996), "Operations Management," 2nd Ed, McGraw Hill, India.
4. Barnes, Ralph, M, (2000), "Motion and Time Study," Design and Measurement of work., John Wiley and Sons.
5. Mandhav, N.Sinha and Wilborn O. Water, (1989), "Management of Quality Assurance," Johan Wiley and Sons.
6. Chase (2002), "Production and Operation Management," 9th Ed., Tata McGraw Hill, New Delhi.

Software required: MS Excel, MS Project.

MTI – 102
CREATIVE PROBLEM SOLVING

Contact hours/semester: 50 **L-3:T-1:P-0**

The course is designed to provide an understanding of problem solving with a touch of creative focus in a systemic framework. Considering the huge breakthrough competitiveness opportunities for industry in India in emerging knowledge economy, This course will help students to understand relevant opportunities/problems and innovative approaches to address them.

UNIT - I

Opportunity / Problem finding, Osborne Parnes Approach. Problem Structuring.India. The Five Step Discovery Process (Shiba, 2006a). Industry studies. Case studies, caselets and applications.

UNIT - II

Perspectives of Creativity. Managing Creativity. Brainstorming / NGT. Context: Integrating Theme / Emerging Industries. Studies and examples with caselets.

Techniques for Generating Creative Ideas. Brainstorming, NGT, Idea Engineering. Check list... Attribute listing, Morphological analysis. Studies and examples with caselets

Divergent Techniques Synectics applications and cases. Breakthrough Thinking. Innovation. Individual and Group creativity. Organizational Creativity. Innovation for Corporate Renaissance

UNIT - III

Idea Structuring: Graphic Tools, Interpretive Structural Modelling, Relationship Analysis, Interpretive Structural Modelling. Intent / Root Cause Structure. Flexible Systems Management, SAP-LAP analysis, Flexibility influence diagrams. Applications and case studies

UNIT - IV

Scenario Building, Harva Method .Technological Forecasting. Options Field / Profile methodology. Case on Options Field / Profile. Applications and case studies.

UNIT - V

CPS applications.. Creativity applications in Quality / Business Excellence / Knowledge Management. Emerging Issues and Synthesis:

Recommended / Reference Books:

1. Saxena J.P., Sushil and Vrat P., 2006, Policy and Strategy Formulation: An Application of Flexible Systems Methodology, GIFT Publishing, New Delhi.
2. Khandwalla, P.N., Lifelong Creativity: An Unending Quest, Tata McGraw Hill, 2004
3. Khandwalla, P.N., Corporate Creativity: The Winning Edge, Tata McGraw-Hill, 2003.
4. Khandwalla, P.N., Fourth eye: Excellence Through Creativity, A.H.Wheeler and Co., New Delhi.

Term Project

Students should undertake term project with topics in industry /domain (preferably emerging industries such as wireless, nanotech, biotech, advanced manufacturing, fuel cell, hydrogen, space mfg...) of their choice and discuss 2-3 alternate choice etc.

MTI – 103
DESIGN OF EXPERIMENTS

Contact hours/semester: 50 **L-3:T-1:P-0**

Experiments are performed by investigators in virtually all fields of inquiry to discover something about a particular process or system. The objective of this course is to educate students about planning and conducting experiments and about analyzing data so that valid and objective conclusions are obtained.

UNIT - I

Strategy of experimentation, Some typical applications of experimental designs, basic principles, guidelines for designing experiments. Simple comparative experiments: Basic statistical concepts, sampling and sampling distributions, Experiments with a single factor: The Analysis of variance: Analysis of the fixed effects model, model adequacy checking, practical interpretation of results.

UNIT - II

Randomized Blocks, Latin Squares & Related designs: Randomized complete block designs, Latin Square design, the Graeco-Latin Square design, balanced incomplete block designs. Factorial design: Basic definitions and principles, the advantage of factorials, the two factor factorial designs, statistical analysis of the fixed effects model, model adequacy checking, estimating the model parameters, the assumption of no – interaction in a two factor model, one observation per cell.

UNIT - III

The general factorial design, 2^k factorial designs: The 2^2 design, the 2^3 design, Yate's Algorith, the General 2^k factorial design, confounding the 2^k factorial design in 2^p blocks.

UNIT - IV

Two level fractional factorial design: introduction; the one half fraction of the 2^k design; the one quarter fraction of the 2^k design; the Taguchi design: orthogonal array, signal-to-noise ratio, mean response table, analysis of variance, Examples of L_8 and L_9 Taguchi design.

UNIT - V

Fitting regression models: Introduction; multiple linear regression models; estimation of the parameters in linear regression models; Hypothesis testing in multiple regressions, test for significance of the regression.

Recommended / Reference Books:

1. Montgomery Douglas C. (2005), Design & Analysis of Experiments, 5th Ed. John Wiley and Sons, New York.
2. Angela M. Dean and Daniel Voss (2000). Design and Analysis of Experiments, Springer, NY.
3. Jiju Antony (2003). Design of Experiments for Engineers and Scientists. 1st Ed. Butterworth-Heinemann.
4. Hines and Montgomery. (1990), Probability and Statistics for Engineers, John Wiley and Sons, NY.

Software required: DesignExpert, Minitab and SPSS

Pre-requisite & associated laboratory: Engineering Statistics for decision making.

MTI – 104
PROJECT MANAGEMENT

Contact hours/semester: 50 **L-3:T-1:P-0**

This course has been structured to help the students to understand major concepts and terminology in project management. They would be able to understand Project Management in regard to Strategy, Environment and Resources. At the end they would be able to understand how functional areas interact to influence project performance. This will help students to manage a project that create better integration between functional areas.

UNIT – I

Project Integration Management: Project Plan Development. Project Plan Execution. Overall Change Control. Project Scope Management: Initiation. Scope Planning. Scope Definition. Scope Verification. Scope Change Control.

UNIT – II

Project Time Management: Activity Definition. Activity Sequencing. Activity Duration. Estimating. Schedule development. Schedule Control. Project cost Management. Resource Planning. Cost Estimating. Cost Budgeting. Cost Control.

UNIT – III

Project Quality Management: Quality Identification. Quality Assurance. Quality control Project Human Resource Management: Organizational Planning. Staff Acquisition. Team Development.

UNIT – IV

Project Communication: Communication Planning, Information Distribution. Performance Reporting. Administrative closure. Project Risk Management. Risk Identification. Risk Quantification. Risk Response Development. Risk Response Control.

UNIT – V

Project Procurement Management: Procurement Planning. Solicitation Planning. Solicitation. Source Selection. Contract administration and Contract Close Out.
Project Organization Vs Performing Organization.

Execution of Projects (Practical/Project)

1. Critical Chain methodology
2. PS 8 / MS Project 98 / 2000 software for practice on computer.
3. Earned Value Management
4. Quality Management.
5. PSI. (Project Success Indicator).

Recommended / Reference Books:

1. PM Bok, “Project Management Body of Knowledge”, Prentice Hall of India.
2. Baker and Baker, (1996), “The CIA to Project Management”, Prentice Hall of India, New Delhi.
3. Steve McConnell, (2002),, “Project Management”, WB Publishers.
4. R G Ghaita and Sander L Mckel, (2002), “Practical Project Management” (Pearson Education).
5. Harold Karznor, (2002), “Project Management” CBS Publishers.
6. Silver B & Fergus O Connell. “How to run Successful Project II”, Prentice Hall of India, New Delhi

Softwares: Primevera, MS Project

MTI – 105
TOTAL QUALITY MANAGEMENT

L-3:T-1:P-0

The aim is to promote theoretical knowledge as well as techniques regarding Total Quality Management. The aim is further to apply theoretical concepts and models in practice. After completion the student should be able to develop the ability to identify, analyze and find solutions to problems in relation to TQM. This will also help the students to present and defend his/her conclusions in light of the TQM objectives.

UNIT – I

Quality Concepts, Quality challenge, Quality of design and conformance to design, Integrating Quality with Business Processes Total Quality Management Approach: Quality policy, effective leadership, continuous improvement TQM model, Customer-Supplier Chain, Consequences of Total Quality, company wide quality control, implementing TQM. The pioneers of TQM and their Philosophies: Deming, Juran, Crosby, Fringenbuam, Ishikawa, Taguchi, Shiego and Shingo.

UNIT – II

Quality Systems, Quality systems and procedures, ISO-9000 quality systems and its implementations, ISO 14000 Role of Quality standards.

UNIT – III

Tools and Techniques in Quality, Basic techniques for statistical analysis, Management tools and techniques for Quality.

UNIT – IV

Quality in Engineering and design, Quality function in manufacturing, Quality training and education.

UNIT – V

Participative Quality Improvements, Quality related costs, Quality audit and reviews, Quality measurements, Case studies.

Recommended / Reference Books:

1. Besterfield H. David, Besterfield H. Glen, Besterfield-Michael Carol & Besterfield-S Mary, "Total Quality Management", 2nd Ed., Pearson Education, Asia.
2. Bounds Grey, Yorks Lyle, Adams Mel & Ranney Gipsie. "Beyond Total Quality Management toward the Emerging Paradigm", McGraw Hill International Edition.
3. Oakland S. John., "Total Quality Management Text with cases", B.H. Contemporary Business Series.
4. Juran J.M. & Geyna M. Frank, "Juran's Quality Control Handbook", 4th Ed. McGraw Hill International.

Prerequisite: Engineering Statistics and Operations Management.

MTI – 106
SUPPLY CHAIN MANAGEMENT

Contact hours/semester: 50 **L-3:T-1:P-0**

The objective of supply chain is to maximize the overall value generated. The value a supply chain creates the difference between what the final product is worth to the customer and the effort the supply chain expends in filling the customer's request. This will help students to apply the interdisciplinary approach of Supply Chain in value creation.

UNIT - I

Basics of Supply Chain Management

Understanding the supply chain, Nature and scope of supply chain management, supply chain performance: achieving strategic fit & scope, decision phases, supply chain flows, supply chain drivers and obstacles, supply chain strategies.

UNIT - II

Network Design in the Supply Chain

Introduction, role of network design in the supply chain, factors influencing Network Design Decisions, a framework for Network Design Decisions, Models for facility location, Capacity allocation.

UNIT - III

Inventory Management and Risk Pooling

Role of inventory in supply chain, vendor managed inventory (VMI), a single warehousing inventory example, risk pooling, centralized versus decentralized systems, managing inventory in the supply chain, Managing uncertainty in the supply chain, Bullwhip effect, role of safety inventory in the supply chain.

UNIT - IV

Distribution Strategies and Strategic Alliances

Introduction, centralized versus decentralized control, Distribution strategies- direct shipment and cross docking, transshipment, central versus local facilities, push versus pull systems, framework for strategic alliances, third party logistics, retailer-supplier partnerships, distributor integration.

UNIT - V

Information Technology and Supply Chain Management

Role of Information Technology in a supply chain, Supply chain IT framework, Information Technology infrastructure, Customer Relation Management, Future of IT in the supply chain, Supply chain IT practices, E-commerce, E-Business in the supply chains, E-Business Framework, E-business practices, Emerging Issues.

Recommended / Reference Books:

1. Sunil Arora and Mandal, Supply Chain Management
2. Raghuram, Supply Chain Management
3. Deshmukh and Moharty, Supply Chain Management
4. Balloer, Business logistics and supply chain Management
5. Sahai, Supply Chain Management (MDI)

MTI – 107
MANAGEMENT INFORMATION SYSTEM

Contact hours/semester: 50 **L-3:T-1:P-0**

This subject introduces a student to the information flow at inter and intra organizational level. Information management is an essential part of present day economy right from need identification, product development, sales to after sales services. Understanding this information flow is paramount for every executive who wants to have a noticeable share in today's economy. Apart from theoretical concepts this paper will also deal with tools like excel and access to solve some real life problems.

UNIT - I

Organizations, Management and the Networked Enterprise

- Information Systems in Global Business Today
- Global E-Business: How Businesses Use Information Systems
- Information Systems, Organizations, and Strategy

UNIT - II

Information Technology Infrastructure

- IT Infrastructure and Emerging Technologies
- Foundations of Business Intelligence: Databases and Information Management
- Telecommunications, the Internet and Wireless Technology

UNIT - III

Ethical, Social and Security Issues

- Ethical and Social Issues in Information Systems
- Securing Information Systems

UNIT - IV

Key System Applications for the Digital Age

- Achieving Operational Excellence and Customer Intimacy: Enterprise Applications
- E-Commerce: Digital Markets, Digital Goods
- Enhancing Decision Making

UNIT - V

Building and Managing Systems

- Building Information Systems
- Project Management: Establishing the Business Value of Systems and Managing Change
- Managing Global Systems

Recommended / Reference Books:

1. Jane P. Laudon and Kenneth C. Laudon, Management Information Systems: Managing the Digital Firm & Multimedia Student CD Package, 10th Edn., Pearson Education.

MTI – 108
HUMAN FACTOR ENGINEERING

Contact hours/semester: 50 **L-3:T-1:P-0**

The syllabus portrays human factors as a environmental, organizational job factors, human and individual characteristics which influence behavior at work and illustrates how careful consideration of human factors can improve health and safety by reducing the no. of accidents and cases of ill–health at work.

UNIT - I

Ergonomics and Anatomy: Introduction to ergonomics: The focus of ergonomics, ergonomics and its areas of application in the work system, a brief history of ergonomics, attempts to humanize work, modern ergonomics, future directions for ergonomics. Anatomy, Posture and Body Mechanics: Some basic body mechanics, anatomy of the sprine and pelvis related to posture, posture stability and posture adaptation, low back pain, risk factors for musculoskeletal disorders in the workplace, behavioural aspects of posture, effectiveness and cost effectiveness, research directions.

UNIT - II

Human Behaviour: Individual differences, Factors contributing to personality, Fitting the man to the job, Influence of difference on safety, Method of measuring characteristics, Accident Proneness. Motivation, Complexity of Motivation, Job satisfaction. Management theories of motivation, Job enrichment theory. Frustration and Conflicts, Reaction to frustration, Emotion and Frustration. Attitudes -Determination of attitudes, Changing attitudes Learning, Principles of Learning, Forgetting, Motivational requirements.

UNIT - III

Anthropometry nnd Work Design For standing And Seated Works: Designing for a population of users, percentile, sources of human variability, anthropometry and its uses in ergonomics, principals of applied anthropometry in ergonomics, application of anthropometry in design, design for everyone, anthropometry and personal space, effectiveness and cost effectiveness. Fundamental aspects of standing and sitting, an ergonomics approach to work station design, design for standing workers, design for seated workers, work surface design, visual display units, guidelines for design of static work, effectiveness and cost effectiveness, researc h directions.

UNIT - IV

Man-Machine System And Repetitive Works And Manual Handling Task: Applications of human factors engineering, man as a sensor, man as information processor, man as controller – Man vs Machine. Ergonomics interventions in Repe titive works, handle design, key board design- measures for preventing in work related musculoskeletal disorders (WMSDs), reduction and controlling, training Anatomy and biomechanics of manual handling, prevention of manual handling injuries in the work place, design of manual handling tasks, carrying, postural stability.

UNIT - V

Human skill & performance and display, controls and virtual environments:A general information-processing model of the users, cognitive system, problem solving, effectiveness. Principles for the design of visual displays - auditory displays- design of controls- combining displays and controls- virtual (synthetic) environments, research issues.

Recommended / Reference Books:

1 Mark S Sanders, Ernest J Mccormi,"Human Factors In Engineering & Design", 1993, MGH Book Company.

2 R.S. Bridger ,"Introduction to Ergonomics", Taylor & Francis, 2 edition, 2007.

3 Dan Mc Leod, "The Ergonomics Manual", Philip Jacobs & Nancy Larson.

MTI – 109
RELIABILITY ENGINEERING

Contact hours/semester: 50 **L-3:T-1:P-0**

To explain how system reliability can be measured and how its affect the system performance in context to various aspects (like cost, performance, etc.)

UNIT - I

Reliability: Definition of reliability, types of failures, definition and factors influencing system effectiveness, failure, failure density, failure rate, hazard rate, pdf, cdf,, life characteristic phases, areas of reliability, importance of reliability

UNIT - 2

System Reliability: Types of system- series, parallel, series parallel, stand by and complex; development of logic diagram, methods of reliability evaluation; cut set and tie-set methods, matrix methods event trees and fault trees methods, reliability evaluation using probability distributions, Markov method.

UNIT - 3

Reliability Analysis: Reliability allocation or apportionment, Reliability block diagrams and models, reliability predictions from predicted unreliability, material strengths and loads, reliability testing and reliability growth testing.

UNIT - 4

Reliability Improvements: Methods of reliability improvement, component redundancy, system redundancy, types of redundancies-series, parallel, series – parallel, stand by and hybrid, effect of maintenance. Reliability – cost trade- off, MTTR, MTBF, Reliability and Availability Functions, Important Applications

UNIT - 5

Reliability Management: Reliability testing, reliability and life cycle costs, reliability allocation – maintenance and replacement model, case studies done in Indian perspectives, nonparametric reliability

Recommended / Reference Books:

1. Reliability Engineering, L.S. Srinath, Affiliated East-West Press, New Delhi.
2. Reliability Engineering, A.K.Govil, Tata Mc-Graw Hill, New Delhi.
3. Reliability Engineering, L.Balagurusamy, Tata Mc-Graw Hill, New Delhi, 1984.
4. Reliability in Engineering Design, K.C. Kapur and L.R. Lamberson, Wiley Publications.
5. Reliability Engineering, D.J. Smith, 1972, E.W. Publications.
6.. M.L. Shooman, “Probabilistic Reliability, An Engineering Approach”, McGraw Hill. 5. G. H.Sandler, “System Reliability Engineering”, Prentice Hall.
7. R.Billintan & R.N. Allan,” Reliability Evaluation of Engineering and Systems”, Plenum Press.
8. S.K. Sinha & B.K. Kale,”Life Testing and Reliability Estimation”, Wiely Eastern Ltd.

Software required: Relia-Soft

Pre-requisite & associated laboratory: Statistics for decision making

MTI – 110
KNOWLEDGE MANAGEMENT

Contact hours/semester: 50 **L-3:T-1:P-0**

We are living in a hyper competitive globalised world. Today knowledge is considered one of the most important strategic resources. Knowledge primarily lying with people is most critical to be managed efficiently. Therefore organizations must strive to retain people if not then at least knowledge that these people carry. Knowledge Management is very creative and challenging area. Different aspects of this discipline will be discussed in this course along with cases.

UNIT - I

Knowledge Management

- Introduction – KM's value proposition
- The knowledge Edge – imperatives of KM
- The Origins of Knowledge – transition from Information Management to KM
- The 10 step KM road map – KM in your company

UNIT - II

Infrastructure Evaluation

- The leveraged Infrastructure – using the existing IT platform
- Aligning KM with Business Strategy

UNIT - III

KM System Analysis, Design and Development

- The KM Platform – the seven layers of KM architecture
- Knowledge Audit and Analysis – of existing KM asset
- Designing the KM team – right-sized and well-balanced team
- Creating the KM System Blueprint – a "future-proof" blueprint
- Developing the KM System – developing and integrating KM system

UNIT - IV

Deployment

- Prototyping and Deploying – result driven incrementalism (RDI) methodology
- Leadership and reward structure – reward structure, cultural change and leadership needed for making KM successful

UNIT - V

Evaluation

- Real Option Analysis for Knowledge Valuation – real-option analysis, balanced scorecards, quality function deployment, Tobin's q

Recommended / Reference Books:

1. Amrit Tiwana. *The Knowledge Management Toolkit, Second Edition,* Pearson Education.

MTP – 101
COMPUTER INTEGRATED MANUFACTURING

Contact hours/semester: 50 **L-3:T-1:P-0**

To gain understanding of CIM and its application in manufacturing.

UNIT - I

Introduction to CIM and the Manufacturing Enterprise:

The manufacturing enterprise, introduction, external and internal challenges, world class order winning criteria, learning CIM concepts. Manufacturing systems, manufacturing classifications, product development cycle, enterprise organization, and manual production operations.

UNIT - II

The Design Elements and production Engineering:

Product design and production engineering, organization model, the design process, concurrent engineering, production engineering. Design automation: CAD, Introduction to CAD systems, general system operation, CAD classification: hardware and software, application of CAD to manufacturing systems, CAE, 2D and 3D transformations, analysis, different types of curves, surfaces BEZIER, B-Spline to NURBS.

UNIT - III

Managing the Enterprise Resources:

Operations Management, manufacturing planning and control, manufacturing resources planning, material requirement planning, priority control and dispatching techniques, shop loading, master production schedule, inventory management, capacity requirement planning, MRP-II, just in time manufacturing, emergence of lean production.

UNIT - IV

Enabling Processes and Systems for Modern Manufacturing:

Material and machine processes, flexible manufacturing, fixed high volume automation, automated inspection, quantitative analysis of inspection, quality, total quality management, quality tools and processes, defect free design philosophy, self directed work teams.

UNIT - V

Production Support Machines and Systems:

Industrial Robots, automated material handling, automated guided vehicles, automated storage and retrieval, NC/CNC programming, CNC tooling, CNC machine tools and control systems.

Recommended / Reference Books:

1. Computer Integrated Manufacturing by JAMES A REHG and HENRY W. KRAEBBER, Pearson Education, second edition.
2. Automation, Production System, and computer Integrated manufacturing by MIKELL P. GROOVER, Pearson Education, second edition
3. CAD CAM by P.N. Rao, Tata McGraw Hill, Second edition.
4. Introduction to Statistical quality Control by DOUGLAS C. MONTGNOMERY, Wiley Publications, fourth edition.

Software required: CNC MILLING and CNC TURNING, MASTER CAM Package.

MTP – 102
MODERN MANUFACTURING METHODS

Contact hours/semester: 50 **L-3:T-1:P-0**

Modern Manufacturing method course is designed to acquaint students the latest technological developments in area of manufacturing processes

UNIT - I

Need for new technology materials and processes. Classification of new technology. Historical Background of New Technological Processes. Definitions and Applications of Advances in Machining: Machining Speed Considerations, Advanced Cutting Tool Materials, High Speed Machining, Ultra Precision Machining, Hard Turning.

UNIT - II

Super-Finishing Processes: Need, classification, process principle and applications of Abrasive Flow Finishing, Magnetic Abrasive Flow Finishing, Magnetic Abrasive Finishing, Electrogel Magnetic Abrasive Finishing, Magneto-Rheological Finishing. .

UNIT - III

Advances in Forming: Explosive/Magnetic-pulse/Peen forming processes, Manufacturing of Honeycomb Structure, Electro hydraulic forming, Electro magnetic forming, Laser Bending, Powder rolling, Spray rolling, Hydro forming, Hydrostatic and Powder extrusion, rotary and isothermal forming.

UNIT - IV

Advances in Foundry: - Investment Casting, Single Crystal Casting, Continuous Casting and Rolling Mills, Squeeze Casting and Semi-solid Metals Forming, Shaping of Ceramics.

UNIT - V

Surface Coating and Joining Processes, Flux Cored Arc Welding, Under Water Welding, and Welding of Ceramics.

Surface Coating: Coating of Ceramics- Brief introduction to Vapor Deposition, Sol-Gel, Metallization, Thermal Spraying etc. Chemical Vapor Deposition and Physical Vapor Deposition. Rapid Prototyping: Introduction to regenerative manufacturing process like SLS, LOM. Fused Deposition Manufacturing

Recommended / Reference Books:

1. M V Grower- Modern Manufacturing Process, John Wiley
2. Adithan M. 'Modern Machining Methods" S. Chand & Company Ltd.
3. Bhattacharya Amitabha, "New Technology", Institution of Engineers (India).
4. Pandey P.C. and Shan H.S. " Modern Machining Processes" Tata McGraw Hill, New Deihi
5. V.K.jair1, .Advance Machining Processes, .A.Ilied Pubiisher
6. Ghosh and Malik, Manufacturing Science, E\NP Private Ltd.
7. ASM Handbook-Vol 1 0.

MTP – 103
FOUNDRY TECHNOLOGY

Contact hours/semester: 50 **L-3:T-1:P-0**

To impart knowledge to the students on various aspects of metal foundry practices and various operations involved in it. Apart from metal melting, mould design and special metal casting processes the course also aims to disseminate knowledge on health, safety and environment related issues associated with the foundry operations.

UNIT - I

Selection of Metals and alloys for Casting. Melting Furnaces (Crucible Electric Arc Induction cupola et) and Melting of Metals. Melting Fluxes, Role and Functions of Fluxes. Solidification of Castings, Solidification time of Castings.

Heat Treatment of Casting: Principles of various heat treating processes, the effect of processing on the properties of metals and the dependence of metal properties upon alloying

UNIT - II

Casting Design considerations: Design and Design Considerations for Mould, Gating System, Riser. Spiral Mould Method for Checking Fluidity. Gating Ratio. Aspiration Effect. Filling Time Estimation.

Casting Defects: Their causes and their removal. Cleaning of Casting,

UNIT - III

Inspection, repairs and salvage of Casting: Detection of defects, cracks, and inclusions within solids by means of radiation, elastic strain energy, electromagnetism, optics, etc. Quality Control in Foundries

UNIT - IV

Special Casting Processes: Sand Mould Casting, Shell Mould Casting, Investment Casting, Die Casting, Single Crystal Component Casting.

Specific Foundry Considerations for Grey CI, Steel and non-ferrous Foundry Practices. Foundry Mechanization.

UNIT - V

Pollution Control in Foundries: Possible Sources of Pollution in Foundries, e. g.: Water Treatment Units, Workshops and Garage, Storage Facilities, Air Emissions for various furnaces and casting processes

Recommended Text / Reference Books:

1. M.P. Groover “Principles of Foundry Technology”, Wiley India Pvt Ltd, New Delhi, 2009.
2. Amitabh Gosh, Asok Kumar Mallick, “Manufacturing Science”, East West Publication.
3. Rao P.N., “Manufacturing Technology”, Tata McGraw Hill, 2003.
4. Ramana Rao T.V., “Metal Casting Principles & Practices”, New Age INT, New Delhi, 2003.
5. Heine & Rosenthal, “Principle of Metal Casting”, Tata McGraw Hills, New Delhi, 2003.
6. A.K. Chakrabarti, Casting Technology and Cast Alloys. PHI Learning
7. A.K. Chakrabarti, Steel Making, PHI Learning
8. Lindberg R.A., “Processes & Materials of Manufacture”, Prentice Hall Publication, 1998.

Software required: Appropriate Multimedia, Simulation & Animations system e.g. Calcosoft, Mavisflow & FEMAP etc.

MTP – 104
TOOL DESIGN

Contact hours/semester: 50 **L-3:T-1:P-0**

This course has been designed to expose students to different techniques that can be helpful in Tool design used by industries.

UNIT - I

Introduction, Classification of machine Tools, Elements of machine tools, selection of speed and feed, gear box design, various types of clutch systems, Sohopke and Report drive/s. double bound gears analysis, Lohr Criterion for optimizing double bond gear. Stepless drive, Mechanical stepless drive analysis, Hydraulic stepless drive circuit analysis, Design features, Throttle valves, Tracer controlled hydraulic circuit, Hydraulic servo controls, Electrical stepless drive circuits and characteristics.

UNIT - II

Strength and Rigidity consideration, process capability and compliance, Design of Lathe Bed, use of stiffness in bed, design of radial drill column and milling machine column. Analysis of spindle bearings, slides and guide, design of spindle/arbor, antifriction and journal bearing. Hydrodynamic action in slides, analysis of hydrostatic bearings, Roller guides, recirculating ball analysis, stick slip motion in guidesmodels, force analysis of Lathe guide ways.

UNIT - III

Vibration of machine tools and dynamic rigidity: Effect of vibrations, source of vibrations, self excited vibration, single degree of freedom chatter, velocity principle and related models, regenerative principles, chatter in lathe, drilling, milling & grinding, Tlusty and palace model, Peters model, Elementation of machine tool structures matrix. Finite elements and lumped constant models.

UNIT - IV

Automation: Automation drives for machine tools, Degree of automation, Semiautomation, analysis of collect action, design of collect, bar feeding mechanism, tooling layout, single spindle mechanism, analysis, swiss type automatic machine. Loading and unloading. Transfer- devices, Modulator- design concept, in process gauging.

UNIT - V

Control system of machine tools: control, mechanical, electrical, hydraulic, numeric and fluidic. Basic principle of control, hydraulic controls, fluid controls, numerical controls, feed back systems, Primary systems programming

Recommended / Reference Books:

1. Machine tools design by Mehta: Tata McGraw Hill
2. Principles of machine tools by Sen et al Central Book Agency
3. Machine Tool Design by Bassu & Pal: Oxford & IBH
4. Machine tool Design vol. i to iv by Acherken: Mir Publishers
5. Design Principles of Metal cutting machine tools: Koenigsberger: Pergamon.

MTP – 105
METROLOGY

Contact hours/semester: 50 **L-3:T-1:P-0**

Measurements play a vital role in every field of investigation. Metrology is the science of measurement. The objective of this course are to: enable students to perform thorough evaluation of newly developed products, to ensure that component designed is within the process and measuring instrument capability available in the plant; minimize the cost of inspection by effective and efficient use of available facilities, and to reduce the cost of rework; standardise the measuring method; maintain the accuracies of measurements and prepare designs for all gauges and special inspection fixtures.

UNIT - I

Standards of Measurement: Line, End and Wavelength standards. Primary secondary and working standards. Limits, Fits & tolerances, Interchangeability, use of slip gauges, dial indicators, sine bars, auto-collimators.

UNIT - II

Instruments for Measuring Surface finish & Roughness: Classes of instruments, the Mitutoyo Surftest, numerical assessment of roundness. Optical projectors and microscopes, straightness, flatness and squareness testing.

UNIT - III

Calibration of Working Standards by Interferrometry: Application of interferometry, calibration of gauges by interference method, the absolute length gauge interferometer.

UNIT - IV

The Calibration of working standards by direct comparison in series: Different types of comparators such as the pneumatic, optical, electrical and electronic comparators principle of amplification and magnification, sensitivity and response, the calibrations of end gauges in sets, ruling and calibration of standard scales.

UNIT - V

Measurement of Gear and Screw Threads: Measuring methods for pitch, profile, lead, tooth thickness, composite elements, inspection equipment, quality control, screw thread terminology, measurement over wires, one wire measurement, three wire measurement, standard specifications and formulas, tolerances, thread gauge measurement; measurement, measuring equipment, application of thread gauges.

Recommended / Reference Books:

1. Gupta, I.C.(2012), Textbook of Engineering Metrology, Dhanpat Rai & Sons, New Delhi, India.
2. Miller, L. (1962), Engineering Dimentional Metrology, E. Arnold.
3. Khare, M.K., Vajpayee, S., Dimensional Metrology, Oxford and IBH Publishing, India
4. Jain, R.K. (1997), Engineering Metrology, Khanna Publishers, New Delhi, India.

MTP – 106
WELDING TECHNOLOGY

Contact hours/semester: 50 **L-3:T-1:P-0**

The objective of this course is to impart knowledge to the students about latest welding technology that is being used by industries.

UNIT - I

Metallurgical structure of weldments, different characteristic zones of a fusion welded joint. Weldability of steels, stainless steels, aluminum, copper and titanium based alloys. Classification of welding processes. Welding consumables e.g. electrodes, filler wires, gasses and fluxes.

UNIT - II

Principles and Science of specific fusion welding techniques such as SMAW, SAW, GMAW, GTAW and FCAW. Principles of other welding and allied processes such as Gas welding, flame cutting and resistance welding.

UNIT - III

Weld Design and Quality Control: Welding joint design, principles of welded joint design, welding positions, welding defects and discontinuities. Assessment of weld quality, NDTs used in the testing of weld soundness. Remedies and causes of prominent defects e.g. hydrogen embrittlement, stress corrosion cracking, porosity and inclusion.

UNIT - IV

Mechanisation in Welding: Mechanisation of flat/circular joints, Thin/thick sheets (resistance/arc weld), Longitudinal circumferential SA welding (roller blocks, column booms, flux supports), Circular/spherical welding joints (rotating tables positioners), Manufacture of welding lngitudinally welded pipes by induction, TIG, Plasma and SA welding of spiral welded pipes.

UNIT - V

Modern Trends in Welding: Use of Robots in Welding in major industrial segment e.g. Automobile, Aerospace and Jewelry manufacturing. Modern welding processes such as Friction Stir Welding, Friction Welding, Explosive Welding, USW, PAW, LBM, EBM.

Recommended / Reference Books:

1. Welding Technology and Design, VM Radhakrishnan, New Age International
2. Advanced Welding Processes, Nikodaco & Shansky, MIR Publications
3. Source Book of Innovative welding Processes, M.M. Schwariz Americal Society of Metals (Ohio)
4. Manufacturing Technology (Foundry, Forming and Welding), P.N. Rao, Tata McGraw Hill.

MTP – 107
ADVANCED MATERIAL SCIENCE

Contact hours/semester: 50 **L-3:T-1:P-0**

The objective of this course is to impart knowledge to the students about recent advances in material science that is being used by industries.

UNIT - I
Plastic Deformation of Single Crystals- Concept of crystal geometry, Lattice defects, Deformation by slip, slip in a perfect lattice, slip by dislocation movement, critical resolved shear stress for slip, deformation of single crystal, deformation of face centered cubic crystals, deformation by twinning, stacking faults, deformation bands and kink bands, micro strain behaviour, strain hardening of single crystal

UNIT - II
Dislocation Theory- Introduction, observation of dislocation, Berger's vector and dislocation loop, dislocations in face centered cubic lattice, dislocations in hexagonal close packed lattice, dislocation in the body centered cubic lattice, stress fields and energies of dislocations, dislocation climb, intersection of dislocation Jogs, dislocation sources, multiplication of dislocations, dislocation point defect interactions, dislocation pile up.

UNIT - III
Strengthening Mechanisms- Grain boundaries and deformation strengthening from grain boundaries, low angle grain boundaries, yield point, phenomenon of strain aging, solid solution hardening, deformation of two phase aggregates, strengthening from fine particles, strengthening due to point defects. Martensite strengthening, cold worked structure, strain hardening, annealing of cold worked metal, Bauschinger effect, preferred orientation

UNIT - IV
Mechanical Behaviour of Polymeric Materials- Introduction, time dependent mechanical behaviour of polymeric materials, structure of polymers, deformation of polymers, yielding criteria for polymers, Rheology, viscoelastic behaviour, rubber elasticity, fracture and toughness

UNIT - V
Fundamental of Metalworking- Mechanics of Metalworking, Flow stress determination, strain rate effects, deformation zone geometry, workability, residual stresses

Recommended / Reference Books:

1. Fundamentals of Material Science and Engineering- William F Smith
2. Mechanical Metallurgy- Dieter
3. Physical Metallurgy- Reedhill
4. Physical Metallurgy- Van Vlack
5. Physical Metallurgy and Heat Treatment – Lakhtin
6. Physical Metallurgy Avner
7. Theory of Dislocations Hull

THERMAL ENGINEERING

MTT – 101
ADVANCED HEAT AND MASS TRANSFER

Contact hours/semester: 50 **L-3:T-1:P-0**

UNIT - I

Introduction: Brief Introduction to different Modes of heat transfer- Conduction- General heat conduction equation in Cartesian, Cylindrical and Spherical Co-ordinates Composite Geometries, Variable Thermal conductivity, Extended surfaces-, Heat transfer with internal heat generation, Two dimensional heat conduction, Numerical and analytical methods. Finite Difference methods for Heat Conduction Problems

UNIT – II

Forced Convection: Concept of boundary layer- Hydrodynamic and Thermal boundary layer concepts-Equations of Motion and Energy-Methods to determine heat transfer coefficient-Dimensional Analysis –Importance of Non – Dimensional numbers –Analogies between Heat and Momentum Transfer-External flows and integral methods for flow over a flat plate-Application of empirical relations to various geometrics

UNIT – III

Natural convection: Dimensionless parameters of Free convection-An Approximate Analysis of Laminar Free Convection on a Vertical Plate-Free convection on a Horizontal Plate, Cylinder and Sphere- Combined free and forced convection.

UNIT – IV

Radiation: Basic Laws of Radiation, Concept of View factor- Methods of Determining View factors-Radiant heat exchange in Grey, Non- Grey bodies with Transmitting, Reflecting and Absorbing media-Specular surface, Radiation Shields.

Boiling and condensation: Boiling curve – Correlations – Nusselt's theory of film condensation on a vertical plate.

UNIT – V

Mass Transfer: Introduction- Analogy between heat and mass transfer-Mass diffusion- Fick's law of diffusion-Boundary conditions-Steady mass diffusion through a wall,-Mass convection-Analogy between friction, heat transfer and mass transfer coefficients-Significance of Non – Dimensional numbers.

Recommended / Reference Books:

1. Heat Transfer – Necati Ozisik ,Tata Mc-Graw Hill
2. Heat Transfer a basic approach – Yunus Cengel, Mc-Graw Hill
3. Heat Transfer – Holman , Tata Mc-Graw Hill
4. Fundamentals of Heat and Mass Transfer by M.Thirumaleshwar, Pearson Education.
5. Engineering Heat Transfer, by William S. Jana, CRC Press, N.Y
6. Principle of Heat & Mass Transfer – Frank Kreith & Mark. Bohn.

MTT – 102
ADVANCED FLUID MECHANICS

Contact hours/semester: 50 **L-3:T-1:P-0**

Knowledge and understanding of the basic principles and concepts of fluid mechanics are essential to analyze any system in which a fluid is the working medium. The design of all means of transportation requires application of the principles of fluid mechanics. In recent years automobile manufacturers have given more consideration to aerodynamic design. The design of propulsion systems for space flight is based on the principles of fluid mechanics. It is commonplace today to perform model studies to determine the aerodynamic forces on, and flow fields around, buildings and structures.

The design of all types of fluid machinery including pumps, fans, blowers, compressors, and turbines requires knowledge of the basic principles of fluid mechanics. Lubrication is an application of considerable importance of fluid mechanics. Heating ventilating and air-conditioning (HVAC) systems for private homes, large office buildings, and underground tunnels, and design of pipeline systems are further examples of technical problem areas requiring knowledge of fluid mechanics. The circulatory system of the body is essentially a fluid system. It is not surprising that the design of blood substitutes, artificial hearts, heart-lung machines, breathing aides, and other such devices must rely on the principles of fluid mechanics.

The use of computer-based models and simulations to describe fluid flow conditions has numerous advantages for the designer and researcher. The development of computing capacity over the past decade has been exponential and has made possible the implementation of long-recognized numerical solutions through the fast computing. It is now possible to assess the likely effects of design changes without physical testing, computational fluid dynamics (CFD) must be recognized as a powerful tool.

The list of applications of the principles of fluid mechanics could be extended considerably. So the fluid mechanics is not a subject studied for purely academic interest; rather, it is a subject with widespread importance both in our everyday experiences and in modern technology.

UNIT - I (12 pds.)
Introduction, Review of basic concepts and Fluid Properties, Basic laws of Fluid Motion, Internal stresses and External forces on Fluid Element.

Review of concepts in kinematics of Fluid Motion: Vorticity, Circulation, Velocity potential and Stream function, Irrotational Flows.

Integral analysis of fluid flow: Reynolds transport theorem, Integral form of Basic laws,, Momentum theorem, Angular momentum and Energy equations and their applications.

UNIT - II (8 pds.)
Dynamics of ideal fluid motion: Euler's eq. of motion, Bernoulli's eq., Potential flows: Elementary flows, Superposition of elementary flows, source and uniform flow, source-sink pair, doublet, doublet and uniform flow, source-sink and uniform flow, doublet vortex and uniform flow.

UNIT - III (10 pds.)
Differential analysis of fluid flow: Governing equations, Continuity eq., Momentum eq., Exact solutions of Navier-Stokes (N-S) eq., Energy eq. and solution of fluid flow with thermal effects. Low Reynolds number approximation of N-S equations, Creeping flow over sphere, Stokes and Oseen approximation, Hydrodynamic theory of lubrication.

UNIT - IV (10 pds.)

Boundary layer theory: Prandtl's boundary layer equations, Laminar boundary layer over a flat plate, Blausius solution, Falkner-Skan solutions, Approximate methods for solution of boundary layer eqns., von-Karman momentum integral eq., Thermal boundary layer, Laws of drag over flat plate, Effect of pressure gradient, Boundry layer control.

UNIT - V (10 pds.)

Fundamentals of turbulent flows: Reynolds stress tensor, Phenomenological theories of turbulence, Prandtl mixing-length and eddy viscosity concepts, Universal velocity distribution law, Law of the wall and the wake.

Turbulent flow in pipes, Smooth and rough pipes, Drag reduction in pipes.

Recommended / Reference Books:

1. Introduction to Fluid Mechanics by R.W. Fox & A.T. McDonald, John-Wiley and Sons.
2. Foundations of Fluid Mechanics by S.W. Yuan, Prentice Hall.
3. Fluid Mechanics by F.M. White, McGraw-Hill.
4. Viscous Fluid Flow by F.M. White, McGraw-Hill.
5. Advanced Fluid Mechanics by K. Muralidhar & G. Biswas, Narosa Publishing House.

Software required: CFD Software: FLUENT, CFX, START-CD, FLOW-3D

MTT – 103
ADVANCED THERMODYNAMICS

Contact hours/semester: 50 **L-3:T-1:P-0**

UNIT - I

Review of the basic concepts, state and equilibrium system and control volume, processes and cycles, the state postulate, carethodory's formulation, application areas of thermodynamics.

UNIT - II

Energy, energy transfer and general energy analysis, first law applied to closed and open systems, first law analysis of unsteady state and mixed systems, limitations of first law.

UNIT - III

Introduction to second law, equivalence of the two statements, quality of energy, entropy and entropy generation, entropy generation minimization, second law analysis of control volumes and reacting systems, limitations of second law.

UNIT - IV

Mechanism of Entropy generation and Exergy system Destruction, Non flow system, Flow systems, Generalized exergy analysis.

UNIT - V

Case study of exergy analysis, Second Law efficiency, Multi component system analysis Cogeneration, Trigeneration.

Recommended / Reference Books:

1. M. S. Moran and B.N.Shapiro, "Fundamentals of Engineering thermodynamics", Third Ed. New York: John Wiley & Sons 1996.
2. Adrian Bejan, "Advanced Engineering Thermodynamics", Second Ed. New York: Wiley Interscience, 1997.
3. Bognakke, Sontagg and Van Wylen, "Thermodynamics," Fifth Ed. New York: John Wiley & Sons.
4. Onkar Singh, "Applied Thermodynamics," New Age International Publishers, New Delhi.

MTT – 104
TURBOMACHINERY

Contact hours/semester: 50 **L-3:T-1:P-0**

Turbomachineries are device which are capable of maintaining, transforming or converting one form of energy into other form. For instance: turbines, Pumps, fans, blower and compressors are energy converting machines. This is an important constituent of the Mechanical Engineering students. This subject reinforces the basic concept, principle, design, governing and advantages of the different fluid machineries. This subject also provides advance knowledge of the Fluid machinery to Mechanical Engineering students.

UNIT - I

Turbines: Classification, Basic definitions, Different stages, Impulse turbine, Construction details, Velocity triangle, Workdone equation, efficiencies, performance characteristics and uses. Related problems

UNIT - II

Reaction turbines: Classification, Velocity triangle, Construction details, efficiencies and losses, Important relations, Workdone equation, Specific speed, Unit quantities, Characteristic curve. Related problems

UNIT - III

Centrifugal Pumps: Main parts, Workdone relation, Efficiencies and losses. Minimum starting speed, multistage centrifugal pumps, Specific speed characteristic curve. Related problems

UNIT - IV

Reciprocating Pumps: Construction details, Discharge, Workdone and power required to drive the pump. Different losses, Indicator diagrams, Air vessels. Related problems

UNIT - V

Compressors, fans and blowers: Arial Radial compressor stages, stage velocity triangle, stage losses and efficiencies, work done factor, Types of centrifugal fans and blowers, Design parameter. Fan noise losses and fan bearings. Jet propulsion of Turbomachines. Related problems

Recommended Text / Reference Books:

1. S. M. Yahya, 'Turbines, compressors and fans', Tata McGraw Hill.
1. R. K. Bansal, 'Fluid Mechanics and Hydraulic Machines', Laxmi Publication.
2. 'Hydraulic Machines' by Jagdish Lab.
3. Modi and Seth, 'Hydraulic and Hydraulic Machines'.
4. Shephered, D. G., 'Principle of Turbomachinery', Maemillen.

Software required: FLUENT.

Pre-requisite & Associated Laboratory: Turbo Machinery Lab.

MTT – 105
I. C. ENGINE AND AIR POLLUTION

Contact hours/semester: 50 **L-3:T-1:P-0**

UNIT - I

Engine Types and Their Operation: Introduction and Historical perspective – Engine classifications - Engine components - S.I. Engine operation – C.I. Engine operation – Stratified charge engine – working - Rotary Engine –working - Relative merits and demerits.

UNIT - II

Combustion in Spark – Ignition Engines: Introduction – Stages of combustion in SI Engine - Flame front propagation– Factors influencing flame speed - Rate of pressure rise – Analysis of cylinder pressure data – Heat release analysis - Cyclic variations in combustion, partial burning and misfire – Abnormal combustion and knocking – Effects of detonation - Effect of engine variables on detonation – Types of combustion chambers.

UNIT – III

Combustion in Compression – Ignition Engines: Introduction – Stages of combustion in CI Engine – Ignition delay – Factors effecting ignition delay – Knocking in CI Engine – Factors affecting knowing - Types of Diesel Combustion systems – Direct injection systems - Indirect injection systems, comparison of combustion Systems - Combustion in direct injection multi spray – Analysis of cylinder pressure data - Heat release analysis-Types of combustion chambers.

UNIT – IV

Engine Performance and Testing: Introduction - Parameters of performance – Engine performance characteristics – variables affecting performance characteristics - Pressure- Volume measurement and combustion Analysis- Performance test – heat balance test problems

Fuels and their Characteristics, Alternate Fuels: Necessity of Alternative fuels – Biodiesels-Transesterification process – Use of Alcohols – Gaseous fuels -CNG – LPG – Hydrogen and Biogas. Dual fuel operation.

Thermodynamics of combustion – Enthalpy of formation – Heating value of fuel - Adiabatic flame Temperature – Equilibrium composition of gaseous mixtures.

Laminar and turbulent flames propagation and structure – Flame stability – Burning velocity of fuels – Measurement of burning velocity – factors affecting the burning velocity.

UNIT – V

Supercharging of Engines, Methods of Supercharging, Turbocharging, Limitations of Turbocharging Pollutant Formation and Control:

Nature and extent of problem-Pollution Norms- Types of pollutants-Nitrogen Oxides – Carbon Monoxide – Unburned Hydrocarbons – Particulate Emissions – Measurement of Emissions – Oxides of Nitrogen, carbon monoxide, Unburned Hydrocarbons and smoke – Exhaust gas treatment – Catalytic converters – Thermal reactors – Particulate traps.

Recommended Text / Reference Books:

1. Internal Combustion Engine Fundamentals, John. B.Heywood, Mc Graw Hill
2. Internal Combustion Engine and Air Pollution, Obert E.F, Harper and Row Publishers
3. Internal Combustion Engines, V.Ganesan, Tata Mc Graw hill.
4. Internal Combustion Engines, Maleeve V.L, Mc Graw Hill Book Company
5 Internal Combustion Engines, Mathur & Sharma, Dhanpatrai Publishers.
6 IC Engines, Colin R.Ferguson, Allan T.Kirkpatrick, Wiley publishers

MTT – 106
CONVENTIONAL AND NON-CONVENTIONAL ENERGY SOURCES

Contact hours/semester: 50 **L-3:T-1:P-0**

UNIT - I

Sources and Resources for Power Engineering:

Introduction, energy Science in India Power development in India, resources of power generation, present power position in India, future planning for power generation, energy sources for power generation.

UNIT - II

Economics of Power Plants:

General definition- cost analysis cost of hydro plants, economics of combined hydro and steam power plants, plant selection, national water and water grids, combination of wind power with other sources of power, sinking fund method of depreciation, load curve, cost generation stations, energy rates.

UNIT - III

Extraterrestrial and terrestrial radiations, depletion of solar radiation, solar day length, basic sun earth angles, estimation of Intensity of terrestrial radiation, solar radiation on inclined plane surface, solar radiation data, estimation of monthly average, daily, total radiation on horizontal surface, estimation of monthly average, daily diffuse radiation on horizontal surface, monthly average, daily global radiation on titled surface, measurement of solar radiation data.

Solar Thermal Systems: Solar water heaters, solar industrial heating systems, solar refrigeration and air conditioning systems, solar cookers, solar green house.

Solar Photovoltaic Systems: Solar PV systems, solar PV application.

UNIT - IV

Geothermal Energy: Origin and distribution of geothermal energy, types of geothermal resources, environmental consideration, tidal energy, wave energy, ocean thermal energy.

UNIT - V

Wind Energy: Major application of wind energy, wind turbine aerodynamics, wind turbine types and their construction, wind energy conversion systems, environmental aspects.

Biomass Energy: Photosynthesis process, biofuels, biomass resources, biomass gasification, biogas production from waste biomass.

Recommended / Reference Books:

1. B. H. Khan, “Non-Conventional Energy Resources”, Tata McGraw Hill.
2. R. K. Rajput, “Power Plant Engineering”, Publication.
3. M. M. EL-Wakil, ‘Power Plant Engineering’ , McGraw Hill.
4. Renewable Energy Resources, Anamaya Publishers.
5. Culp ‘ Principle of Energy Conversion System’, McGraw Hill Book Co.
6. P.C. Sharma, “ Power Plant Engineering “ S.K. Kataria and sons.

MTT – 107
UTILITY ENGINEERING

Contact hours/semester: 50 **L-3:T-1:P-0**

UNIT - I
Load calculation & applied psychometrics, Revision of basic refrigeration cycles, psychometry. Heat load calculation, psychometric calculations for year round Air conditioning.

UNIT - II
Piping services in building Refrigerant piping, Reverse return system of chilled water system. Warm-air heating systems, Hot water heating systems.

UNIT - III
Air conditioning Equipments, Air curtains, Air filters, humidifiers, dehumidifiers, fans blowers, duct design, grills, registers.

UNIT - IV
Mechanical Services: Drainage and water supply, Design of a fountain for building, Design of a swimming pool.

UNIT - V
Fire protection systems portable equipment, dry system, wet system, sprinkler system, design of a multiplex for fire system, Car parking fire protection, pressurization system for staircase, Fire dampers, hose reel system, Fire tanks in buildings, Introduction to Building Automation System (BAS).

Recommended / Reference Books:

1. P.L.Ballaney, 'Refrigeration & Air conditioning', Khanna Publishers.
2. A.F.P.A. Hand book,
3. I.RV.E. Guide (B) U.K.
4. C. P. Arora, 'Refrigeration & Air Conditioning'.

MTT – 108
GAS DYNAMICS

Contact Hours: 40 Periods **L-3:T-1:P-0**

The objective of this course is to impart Knowledge and understanding of the physical phenomena of gas dynamics and its limitations of applicability of such phenomena. This is designed in such a way that it can prove very helpful in its applications to aero- space engineering as well as in non aero space fields too. It can help professional engineers and physicists both.

UNIT - I

Basic Equation of Compressible Flow: Thermodynamics of fluid flow, first law of thermodynamics, second law of thermodynamics, thermal and calorical properties, perfect gas.

Isentropic Flow with Variable Area: Mach number variation, stagnation and critical states, area ratio as function of Mach No., flow through nozzles and diffusers.

UNIT - II

Flow with Normal Shock Waves: Development of shock waves, the governing equations, Prandtl-Meyer relation, Mach No. downstream of the normal shock wave, change of entropy across the shock, determination of Mach No. of supersonic flows.

UNIT - III

Flow with Oblique Shock Waves: Nature of flow through oblique shock waves, Prandtl's equation, Rankine-Hugoniot equation, variation of flow parameters, Oblique shock relation from normal shock equations.

UNIT - IV

Flow in Constant Area Ducts with Friction: The Fanno curves, Fanno flow equations, solution of Fanno flow equations, variation of flow properties, variation of Mach No. with duct length.

UNIT - V

Flow in Constant Area Ducts with Heat Transfer: The Rayleigh line, fundamental equations, Rayleigh flow relations, Variation of flow properties, maximum heat transfer.

Rarefied Gas Dynamics and High-Temperature Gas Dynamics.

Recommended / Reference Books:

1. S M Yahya, "Fundamental of Compressible Flow", New Age International (P) Limited Publishers.
2. E. Rathakrishnan, "Gas Dynamics", Prentice Hall of India(P) Limited.
3. A. H. Shapiro, "Dynamics and Thermodynamics of Compressible Fluid Flow", Ronalds Press, New Year.
4. Zucrow and Hoffmann, "Gas Dynamics", Wiley.

MTT – 109
LAND FILL GAS: FROM ENVIRONMENT TO ENERGY

L-3:T-1:P-0

UNIT - I

Landfill Gas to Energy: Status and Prospects

Introduction, Importance of landfill gas, overview of landfill gas industry, Phases of LFG Generation, Factors affecting LFG Generation, Energy Potential of LFG, Benefits of LFG to Energy Recovery projects.

UNIT - II

Planning and conceptual design of LFG Recovery System

Criteria for identifying suitability of landfill sites for LFG recovery, LFG recovery from open dumps, controlled landfills, and sanitary landfills, Horizontal and vertical LFG Collection Systems.

UNIT - III

Landfill Gas Flaring

Passive Venting of LFG, Types of Flaring System, Description of LFG Flaring System, Open flaring system versus Enclosed flaring system, case Studies on LFG Flaring Systems.

Unit - IV

Landfill Gas Modeling

Introduction, Conceptualization of LFG Model, Benefits of Landfill Gas Modeling, Sizing LFG collection, and utilization systems, Projections of LFG emissions.

Unit - V

Economic Feasibility of LFG to Energy Projects

Economic feasibility of LFG to Energy project, Evaluation of Costs and Benefits, case studies.

Recommended / Reference Books:

1. From Landfill Gas to Energy: Technologies and Challenges
   Vasudevan Rajaram (Autor), Faisal Zia Siddiqui (Autor), M. Emran Khan (Autor)
   Hardcover: 325 pages
   Publisher: CRC Press; 1 edn. (December 15, 2011)

2. Landfill Gas: From Environment to Energy [Hardcover]
   A Gendebien (Author), M. Pauwels (Author), M. Constant (Author), M.-J Ledrut-Damanet (Author)
   Hardcover: 880 pages
   Publisher: European Commission (31 Dec 1992)

3. Landfill Methane Recovery ("Energy Technology Review" S.) [Hardcover]
   M.M. Schumacher (Editor)
   Hardcover: 558 pages
   Publisher: Noyes Data Corpn.,U.S. (1 Aug 1983)

4. Methane Generation and Recovery from Landfills
   Emcon Associates, Consolidated Concrete Limited
   Hardcover: 150 pages
   Publisher: CRC Press; 1 edition (July 15, 1980)

MACHINE DESIGN

MTD – 101
THEORETICAL AND EXPERIMENTAL STRESS ANALYSIS

Contact hours/semester: 50 **L-3:T-1:P-0**

To bring awareness on experimental method of finding the response of the structure to different types of load.

UNIT - I
ANALYSIS OF STRESS:
State of stress at a point, differential equations of equilibrium, principal stresses, Principal plane transformation of stresses, stress invariants, Airy's stress functions, Lame's stress ellipsoid and its geometric properties. Mohr's circle for the general state of stress.

UNIT - II
ANALYSIS OF STRAINS:
State of strain at a point, normal strain, shearing strain, geometric equation, rigid body displacements, volumetric strains, strain invariants, transformation of strain, compatibility equations, physical equations: stress strain relationship.

UNIT - III
SOLUTION OF SPATIAL PROBLEM:
Stress component in terms of displacement components: in rectangular and polar coordinate system. Infinite elastic layer under gravity and uniform pressure, stretching a prismatic bar by its own weight, pure bending of prismatic bar, torsion of prismatic bar, displacement functions, displacement potential, Love's and Galerkin's displacement functions.

UNIT - IV
THEORY OF PHOTOELASTICITY:
Wave theory of light, wave front, wave equation. Polarization: Types of polarization, linear or plane polarizes. Wave plates (Birefrigent), stress optic law, fringe order, fringe value, circular polarscope, properties of isochromatic and isoclines fringes.

UNIT - V
BRITTLE COATING:
Brittle coating technique, coating stresses, failure theories, crack patterns in brittle coatings, load relaxation technique, refrigeration technique, crack detection, types of brittle coating, testing procedure, calibration of brittle coating.

Recommended / Reference Books:

1. Zhilun Xu, 'Applied Elasticity', Wiley Eastern Limited, New Delhi.
2. Timoshenko and Goodier, 'Theory of Elasticity', McGraw Hill International Edition.
3. Y. C. Fung, 'Foundation of solid mechanics', Prentice Hall.
4. Love A. E. H., Dover, 'A treatise on the Mathematical Theory of Elasticity', New York.
5. Dolly & Rilley, 'Experimental Stress Analysis'.
6. Shrinath, 'Experimental Stress Analysis'.

MTD – 102
ADVANCED MECHANISMS

Contact hours/semester: 50 **L-3:T-1:P-0**

UNIT - I

Contrained motion in kinematic chains, Classification of mechanisms, Motion analysis in complex mechanisms, Eular - Savary equation. Inflection circle, cubic of stationary curvature. Analytical and numerical methods in kinematics.

UNIT - II

Synthesis of mechanisms - Number, Type and Dimensional synthesis, Synthesis of Mechanisms for function generation, path generation and rigid body guidance, Dead centre problems, Analytical methods, Branch and order Defects.

UNIT - III

Kinematics of spatial chains, Matrix method loop closure equation, kinematics of open chains, synthesis of: spatial mechanisms.

UNIT - IV

Dynamics of mechanisms, Dynamic analysis of plane and space mechanisms, earn dynamics.

UNIT - V

Special topics - Mechanisms for automation, Non circular gears, case studies.

Recommended / Reference Books:

1. Amitabh Ghosh and Asok Kumar Malik, Theory of Mechanisms and Machines EWP.
2. Hartenburg & Denavit, 'Kinematic synthesis oflinkages', McGraw Hill.
3. Erdman & Sandor, 'Mechanism Design: Analysis & Synthesis Vol. 1 & Vol. 2', Prentice Hall.
4. Hall,' Applied Kinematics', McGraw Hill.
5. Hirschhorn J, 'Kinematics and Dynamics of Plane Mechanisms', McGraw Hill.
6. Hunt K. H., 'Kinematic Geometry of Mechanisms', Oxford University Press.
7. Suh & Radcliffe, 'Kinematics & Mechanisms Design', Wiley.
8. Tao D. C., 'Applied Linkage Synthesis' Addison Wesley.
9. Soni A. H., 'Mechanism Synthesis and Analysis', McGraw Hill.

MTD – 103
ADVANCED MECHANICAL ENGINEERING DESIGN

Credit: 5 **L-4: T-0:P-2**

UNIT - I

Fundamentals and Applications: Problem solving and design. The design process; stages of design. Codes and Standards. Static body stresses. Failure and failure theories; safety factors, and reliability. Fatigue strength and stress-concentration. Surface contacts and failures. Design for fatigue strength and life. Shaft design. Materials.

UNIT - II

Lubrication: Types of lubrication. Theory and design of boundary-lubricated, pressure-fed, hydrostatic, and elastohydrodynamic bearings. Bearing materials. Lubrication in chain drives. Roller and other chains; chain characteristics; chain capacity and rating. Design of chain drives.

UNIT - III

Bevel and Worm Gears: Bevel gears; bevel gear geometry and nomenclature; bevel gear force analysis. Design of bevel gears. Worm gears; worm gear geometry and nomenclature; worm gear force and efficiency analysis. Design of worm gear sets. Worm gear thermal capacity. Gear materials. Lubrication and mounting of gears. Design of gear reducers.

UNIT - IV

Design against Creep: True stress and strain. Creep of solids; creep phenomenon. Creep parametric methods. Correlation of creep rupture data. Creep under biaxial stresses. Stress-relaxation. Materials for high temperature applications. Design problems.

UNIT - V

Design against Fracture: Introduction. Stress intensity factor. Fracture criterion and fracture toughness. Fatigue crack propagation; plastic deformation around crack tip, and its effect on fatigue crack propagation. Crack opening displacement. Design problems.

Recommended / Reference Books:

1. Ullman, D. G.: The Mechanical Design Process, McGraw-Hill, New York (2008).
2. Spotts, M. F. and T. E. Shoup: Design of Machine Elements, Pearson Education Asia, Inc., Delhi (1998).
3. Burr, A. H. and J. B. Cheatham: Mechanical Analysis and Design, Prentice Hall of India, New Delhi (1997)
4. Shigley, J. E., et al.: Mechanical Engineering Design, McGraw-Hill, Boston (2004).
5. Juvinall, R. C. and K. M. Marshek: Fundamentals of Machine Component Design, John Wiley & Sons, Inc., New York (2002).
6. Mott, R. L.: Machine Elements in Mechanical Design, Prentice Hall, New Jersey (1992).
7. Hamrock, B. J., B. et al.: Fundamentals of Machine Elements, McGraw-Hill, Boston (1994).
8. Norton, R. L.: Machine Design, Pearson Education Asia, Inc., Delhi (2000).
9. Mubeen, A.: Machine Design, Khanna Publishers, Delhi (2003).
10. Pahl, G. and W. Beitz: Engineering Design - A Systematic Approach, Springer-Verlag, London (2007).
11. Dieter, G. E and L. C. Schmidt: Engineering Design, McGraw-Hill, Boston (2009).
12. Farag, M. M.: Selection of Materials & Manufacturing Processes for Engineering Design, Prentice Hall, New York.
13. Boresi, A. P. and R. J. Schmidt: Advanced Mechanics of Materials, John Wiley & Sons, Inc., Singapore (2003).
14. Hearn, E. J.: Mechanics of Materials, Vol. II, Butterworth-Heinemann, Oxford (1997).

MTD – 104
VIBRATION ENGINEERING

Contact hours/semester: 50 **L-3:T-1:P-0**

UNIT - I

Harmonic motion, Periodic motion, Fourier series, Vibration terminology: rms, peak to peak, average values, Decibel, Free vibration, Damped vibrations. Different types of Damping, Equivalent viscous damping.

UNIT - II

Forced vibrations- vibrations with constant harmonic excitation, steady state vibrations, vibration due to rotating and reciprocating unbalance, critical speed of shafts, vibrations due to the excitation ofthe support, vibration measuring instruments, critical speed.

UNIT - III

Two degree of freedom systems, semidefinite systems, 'principal mode and normal mode of vibration, orthogonality of principal modes, vibration absorber, centrifugal pendulum vibration absorber.

UNIT - IV

Multi degree of freedom systems, close coupled and far coupled system, Lagrange's equation, Generalized coordinates, coordinate coupling - static coupling and dynamic coupling, Hamiltor's principle, influence coefficients, Natural frequencies and mode shapes, Eigen values and Eigen vectors.

UNIT - V

Continuous systems, vibration of strings, longitudinal vibrations of bars, lateral vibrations of beams.

Numerical methods- Reyleigh's method, Dumkerley's method, Stodola's method, Rayleigh-Ritz method, Matrix iteration method, Holzer's method.

Introduction to transient and nonlinear vibrations.

Recommended / Reference Books:

1. Thomson, W.T, 'Theory of vibration with applications', Pearson Education.
2. Meirovitch, L., 'Elements of vibration analysis', McGraw Hill.
3. Grover G. K., 'Mechanical vibrations', Nem Chand & Brothers.

MTD – 105
TRIBOLOGICAL SYSTEMS DESIGN

L-3:T-1:P-0

Know how and when to choose a rolling-element bearing, Appreciate the advantages of hydrostatic bearings, and understand how they can be used efficiently, Be able to describe surface roughness at all levels of detail, Understand the role of surface roughness in the contact of engineering surfaces, and how it leads to Amontons' laws of friction, Be able to analyse elastic contacts, including wheel/rail contacts, angular-contact ball-bearings, and traction drives, Understand how a lubricant can separate heavily-loaded contacts, especially between spur-gear teeth and in ball and roller bearings, and be able to estimate the lubricant film thicknesses which occur, Appreciate the problems of traction through a lubricant in a traction drive, Understand the properties of lubricants and be aware of some practical problems in real bearings, Be able to estimate temperatures in dry and lubricated sliding contacts, and understand their importance.

UNIT - I

Introduction : Surface Topography, Physico-Chemical Aspects of Solid Surfaces, Surface Interactions. Characterising surfaces, Statistical description of surfaces.

UNIT - II

Mechanics of solid contacts-Hertz analysis: Elastic Contacts I, Elastic Contacts II, Elastoplastic Contacts.

UNIT - III

Friction: Laws of Friction, Mechanisms of Friction and Friction Space, Friction and Stick Slip, Surface Temperature.

Lubrication: Boundary Lubrication, Solid-Film Lubrication, Hydrostatic Lubrication, Hydrodynamic Lubrication, Elastohydrodynamic Lubrication, Thermo-Elastohydrodynamic Lubrication. Lubricants, Applications.

UNIT - IV

Wear: Classification of Wear and wear minimization techniques. Adhesive Wear, Fretting Wear, Abrasive Wear, Erosive Wear, Corrosive Wear, Oxidational Wear, Impact Wear, Melt Wear, Wear-Mechanism Maps.

UNIT - V

Applications: Tribological design of machine elements and systems; Principles of life-cycle analysis and their application.

Rolling Contacts, Electric Contacts, Magnetic Recording Systems, Microelectromechanical Systems, Joint Prosthesis, Microtribology.

Design of Tribological Surfaces and Troubleshooting a Tribology Problem

Recommended / Reference Books:

1. Bharat Bhushan; Introduction to Tribology
2. K. C. Ludema; Tribological Modelling for Mechanical Designers
3. Bhushan, B., Gupta, B.K, Handbook of tribology : materials, coatings, and surface treatments, New York : McGraw-Hill.

MTD – 106
ROBOTICS

Contact Hrs/Semester: 50 **L-3:T-1:P-0**

To provide an introduction to Robotics and Automation including robot classification, design and selection, analysis, sensing and control, and applications in industry.

UNIT - I

Fundamentals of Robotics: Introduction, Automation and Robotics, A Brief History of Robotics, Laws & Definition of Robot Anatomy & Classification of Robots, Human system & Robotics, Specifications of Robot, Work Volume, Precision of Movement. The Robotics Market, Social Issues and the Future Prospects.

UNIT - II

Robot Arm Kinematics: Introduction to Robot Arm Kinematics, Homogeneous Coordinate transformations, Direct & Inverse Kinematics, Composite Homogeneous transformation matrix. Link, joint and parameters. Denavit Harten Berg Notation, D-H Matrix, Kinematic equations. Exercises on Direct & Inverse Kinematics up to six degree of freedom Robots.

UNIT - III

Robot Arm Dynamics: Introduction to Robot Arm Dynamics. Lagrange-Euler Formulation, Joint Velocities of Robot manipulators, Kinetic & Potential Energy of Robot Manipulators. Newton-Eulr Formation, Generalized D' Alemberts Equations of Motion.

UNIT - IV

Robot Grippers & Grasping: Classification of End Effectors, Mechanical Grippers, Magnetic gripper, Vacuum gripper, Adhesive gripper, MUltifingered gripper - Utah, Okada, Stanford, DGIT Hands. Considerations in Gripper Selection - Force Analysis and Design. Introduction to Robotic Grasping, Screw theory & its application to Multifingered Robotic Grippers.

UNIT - V

Robot Drives, Sensors, Actuators and Control: Robot drive systems-Hydraulic, Pneumatic & Electric. Robot Sensors - Contact & non-contact type sensors. Basic Control Systems Concepts and Models, Controllers, Control System Analysis, Robot Activation and Feedback Components-Position Sensors, Velocity Sensors, actuators, Power Transmission Devices. Robot Joint Control Design.

Recommended / Reference Books:

1. Robotics: Control, Sensing, Vision, and Intelligence, Fu, Gonzales, Lee, McGraw-Hill, New Delhi.
2. Robotics and Control, R K Mittal & I J Nagrath, Tata McGraw-Hill, New Delhi
3. J. J.Craig., 'Introduction to Robotics', Addision Wesley New Delhi
4. M. T. Mason and J. K. Salisbury, "Robot Hands and the Mechanics of Manipulation", Cambridge, Mass.: The MIT Press.

Software Required: Robo Sim, MATLAB, Lab VIEW.

Pre-Requisite: Kinematics & Dynamics of Machines, Instrumentation & Control Engineering.

Associated Lab.: Robotics & Automation Laboratory

MTD – 107
MECHATRONICS

L-3:T-1:P-0

The Objective of this course is to impart the skills and knowledge that are not confined to a single subject area, but a range of engineering disciplines. Students completing a course will be capable of working in a number of interesting areas i.e. process engineering, product design, manufacturing, automation, quality and business process, green engineering and research and development.

UNIT - I: Introduction to Mechatronics: Origin & evolution of Mecha tronics. Objectives, Advantages, And Disadvantages of Mechatronics, System Interfacing, Instrumentation and Control Systems, open and cloosed Loop Systems, Sequential Systems. **Elements** of **Mechatronics:** Sensors and Transducers, Timers. Ssignal Conditioning, Signal Nomenclature, Signal Processing. Digital Logic. Microprocessor-based Digital Control, Basic Elements of control systems, Microprocessor Architecture, Terminology, instruction Types, Addressing Models, Intels 8085A Microprocessor, Microcontrollers, Relay and Programmable Logic Controller.

UNIT - II: Pneumatics & Electro Pneumatics: Introduction to Pneumatics. Air Compression, Distribution and Treatment. Directional Control valves. Electro Pneumatic Components. Circuit Design.Pneumatic Actuation System, Practical Exercises

UNIT - III: Actuators and Mechanisms: Actuator Types And application Areas, Electromechanical Actuators, DC Motors, AC Motors, Fluid Power Actuators, Piezoelectric Actuators, Magnetostrictive Actuators, Memory-metal Actuator, Ion-Exchange Polymer-metal Composites, Chemical Actuator, Mechanisms, Bearings, Belt ,Chain, Pulleys, Gears, Rack and Pinion, Ratchet, Pawl and Crank, Slider and Crank, Cams and Follower, Chain and Sprocket, Geneva Wheel, Four-bar Linkages.

UNIT - IV: Modelling: Systems, Modelling, Mechanical System, Electrical Systems, Fluid Systems, Thermal Systems, Engineering System, Translational Mechanical System with spring, Damper and Mass. Rotational Mechanical Systems with Spring, Damper and Mass, Modelling Electric Motor, Modelling Chamber Filled with Fluid, Modelling Pneumatic Actuator.

UNIT - V: Intelligent Systems and Their Applications: Advance Actuators, Consumer Mechatronics Products, Hydraulic Fingers, Surgical Equipment, Industrial Robot, Autonomous Guided Vehicle (AGV),Drilling Machine, Conveyor-based Material Handling Systems. **Mechatronics in Manufacturing:** Production Unit , Input/Output and Challenges in Mechatronics Production Units, Knowledge Required For Mechatronics in Manufacturing, Main Features of Mechatronics in Manufacturing, Computer Integrated Manufacturing, just- in-Time Production Systems, Mechatronics and Allied Systems.

Recommended Text / Reference Books

1. W. Bolton, 'Mechatronics', Pearson Education, New Delhi..
2. N P Mahalik Mechatronics Principle, concept & Application, Tata McGraw-Hill, New Delhi
3. Robert H. Bishop, 'Mechatronics Hand Book', CRC Press, New York
4. J.R Groot, 'Introduction to Pneumatics', Fluid Power Education Foundation, Milwaukee.

Software Required: MATLAB, EP-I.

Pre-Requisite: Theory of Machines, Manufacturing Process, Basic Electrical & Electronics Engg.

Associated Lab.: Instrumentation & Control Engineering.

MTD – 108
CONCURRENT ENGINEERING

Contact Hrs/Semester: 50 **L-3:T-1:P-0**

UNIT - I

Product Design and Development: Introduction; product life cycle; product development process, sequential engineering, concurrent engineering. Concepts of concurrent engineering, quality of entire process. Product development organisation tools – total quality management; ISO 9000; reverse engineering; group technology etc. Market Identification – customer requirement and needs.

UNIT - II

Concept Generation and Evaluation of Concepts: Brain Storming; functional decomposition; morphological charts. Pugh's concept selection method; measurement scale; weighted decision matrix; AHP and MADM approaches. Concept testing.

UNIT - III

Preliminary/Embodiment Design: Product architecture. Configuration/form Design, Preliminary design for manufacture and assembly; materials and process selection. Industrial design. Prototyping.

Unit - IV

Parametric and Detail Design: Design for X (Quality, Reliability, Maintainability, Serviceability, Environment, Recyclability, Safety, etc.) Improving details – value analysis and design for robustness, Design review; final detail design.

Unit - V

Project Management: Economic analysis – quantitative and qualitative; project trade-offs. Understanding and representing tasks; project planning and scheduling; acceleration and execution; post mortem project evaluation.

Recommended / Reference Books:

1. Ashby, M.F.: Material Design Method, Pergamon Press, Oxford.
2. Boothroid et. al.: Product design for manufacturing & Assembly; Marcel Dekker.
3. Day, R.G.: Quality Function Deployment, Tata McGraw Hill.