PONDICHERRY UNIVERSITY
PUDUCHERRY – 605 014

Branch – II

B TECH DEGREE
IN
MECHANICAL ENGINEERING

Syllabus and regulations

2013-14 ONWARDS

BACHELOR OF TECHNOLOGY PROGRAMME

IN
MECHANICAL ENGINEERING
(EIGHT SEMESTERS)

REGULATIONS

1. Conditions for Admission:

(a) Candidates for admission to the first semester of the eight semester B. Tech Degree programme should be required to have passed:

The higher Secondary Examination of the (10+2) curriculum (Academic Stream) prescribed by the Government of Tamil Nadu or any other examination equivalent there to with minimum of 45% marks (40% marks for OBC and SC/ST candidates) in aggregate of subjects – Mathematics, Physics and any one of the following optional subjects: Chemistry / Biotechnology/ computer Science / Biology (Botany & Zoology) or an Examination of any University or Authority recognized by the Executive Council of the Pondicherry University as equivalent thereto.

(b) For Lateral entry in to third semester of the eight semester B Tech Degree programme:

The minimum qualification for admission is a pass in three year diploma or four years sandwich diploma course in engineering / technology from an AICTE approved institution with at least 45% marks (40% marks for OBC and SC/ST candidates) in aggregate in the subjects covered from 3rd to final semester or a pass in B.Sc. degree from a recognized university as defined by UGC with at least 45% marks (40% marks for OBC and SC/ST candidates) and passed XII standard with mathematics as one of the subject.

Provided that in case of students belonging to B.Sc. stream shall clear the subjects of Engineering Graphics and Engineering Mechanics of the first year Engineering program along with the second year subjects.

Provided further that, the students belonging to B.Sc. stream shall be considered only after filling the supernumerary seats in this category with students belonging to the Diploma stream.

The list of diploma programs approved for admission for each of the degree programs is given in **Annexure A.**

2. Age limit:

The candidate should not have completed 21 years of age as on 1st July of the academic year under consideration. For lateral entry admission to second year of degree programme, there is no age limit. For SC/ST candidates, age limit is relaxable by 3 years.

3. Duration of Programme:

The Bachelor of Technology degree programme shall extend over a period of 8 consecutive semesters spread over 4 academic years – two semesters constituting one academic year. The duration of each semester shall normally be 15 weeks excluding examinations.

4. Eligibility for the award of Degree:

No candidate shall be eligible for the award of the degree of Bachelor of Technology, unless he/she has undergone the course for a period of 8 semesters (4 academic years) / 6 semesters (3 academic years for Lateral Entry candidates) in the faculty of Engineering and has passed the prescribed examinations in all the semesters.

5. Branches of study:

Branch I	: Civil Engineering
Branch II	: Mechanical Engineering
Branch III	: Electronics & Communication Engineering
Branch IV	: Computer Science & Engineering
Branch V	: Electrical & Electronics Engineering
Branch VI	: Chemical Engineering
Branch VII	: Electronics & Instrumentation Engineering
Branch VIII	: Information Technology
Branch IX	: Instrumentation & Control Engineering
Branch X	: Biomedical Engineering

or any other branches of study as and when offered. The branch allocation shall be ordinarily done at the time of admission of the candidate to the first semester.

6. Subjects of study:

The subjects of study shall include theory and practical courses as given in the curriculum and shall be in accordance with the prescribed syllabus. The subjects of study for the first two semesters shall be common for all branches of study.

7. Examinations:

The theory and practical examination shall comprise continuous assessment throughout the semester in all subjects as well as university examinations conducted by Pondicherry University at the end of the semester (November / December or April / May)

(a) Theory courses for which there is a written paper of 75 marks in the university examination.

The Internal assessment marks of 25 has to be distributed as 10 marks each for two class tests and 5 marks for class attendance in the particular subject. The distribution of marks for attendance is as follows.

5 marks for 95% and above

4 marks for 90% and above but below 95%

3 marks for 85% and above but below 90%

2 marks for 80% and above but below 85%

1 mark for 75% and above but below 80%

In total, three tests are to be conducted and the better two are to be considered for assessment.

(b) Practical courses for which there is a university practical examination of 50 marks:

The internal assessment marks of 50 has to be distributed as 20 marks for the periodic practical works and records submitted thereof, 15 marks for an internal practical examination, 5 marks for an internal viva voce, and 10 marks for class attendance in the particular subject. The distribution of marks is as given below.

10 marks for 95% and above

8 marks for 90% and above but below 95%

6 marks for 85% and above but below 90%

4 marks for 80% and above but below 85%

2 marks for 75% and above but below 80%

8. Requirement for appearing for University Examination:

A candidate shall be permitted to appear for university examination at the end of any semester only if:

(i)He / She secures not less than 75% overall attendance arrived at by taking into account the total number of periods in all subjects put together offered by the institution for the semester under consideration.
(*Candidates who secure overall attendance greater than 60% and less than 75% have to pay a condonation fee as prescribed by University along with a medical certificate obtained from a medical officer not below the rank of Asst.Director*).

(ii) He / She earns a progress certificate from the Head of the institution for having satisfactorily completed the course of study in all the subjects pertaining to that semester.

(iii) His / Her conduct is found to be satisfactory as certified by the Head of the institution.

A candidate who has satisfied the requirement (i) to (iii) shall be deemed to have satisfied the course requirements for the semester.

9. Procedure for completing the course:

A candidate can join the course of study of any semester only at the time of its normal commencement and only if he/she has satisfied the course requirements for the previous semester and further has registered for the university examinations of the previous semester in all the subjects as well as all arrear subjects, if any.

However, the entire course should be completed within 14 consecutive semesters (12 consecutive semester for students admitted under lateral entry).

10. Passing Minimum:

(i)A candidate shall be declared to have passed the examination in a subject of study only if he/she secures not less than 50% of the total marks (internal assessment plus University examination marks) and not less than 40% of the marks in University examination.

(ii) A candidate who has been declared “Failed” in a particular subject may reappear for that subject during the subsequent semester and secure a pass. However, there is a provision for revaluation of failed subjects provided he/she fulfills the following norms for revaluation.

(a) Applications for revaluation should be filed within 4 weeks from the date of declaration of results or 15 days from the date of receipt of marks card whichever is earlier.

(b) The candidate should have attended all the college examinations as well as university examinations.

(c) If a candidate has failed in more than four papers in the current university examination, his/her representation for revaluation will not be considered.

(d) The request for revaluation must be made in the format prescribed duly recommended by the Head of the Institution along with the revaluation fee prescribed by the university.

Further, the University examination marks obtained in the latest attempt shall alone remain valid in total suppression of the University examination marks obtained by the candidate in earlier attempts.

11. Award of Letter Grades:

The assessment of a course will be done on absolute marks basis. However, for the purpose of reporting the performance of a candidate, letter grades, each carrying certain points, will be awarded as per the range of total marks (out of 100) obtained by the candidate, as detailed below:

Range of Total Marks	Letter Grade	Grade Points
90 to 100	S	10
80 to 89	A	9
70 to 79	B	8
60 to 69	C	7
55 to 59	D	6
50 to 54	E	5
0 to 49	F	0
Incomplete	FA	

'F' denotes failure in the course. 'FA' denotes absent / detained as per clause 8.

After results are declared, grade sheets will be issued to the students. The grade sheets will contain the following details:

(a) The college in which the candidate has studied.

(b) The list of course enrolled during the semester and the grades scored.

(c) The Grade Point Average (GPA) for the semester and the cumulative Grade Point Average (CGPA) of all enrolled subjects from first semester onwards.

(d) GPA is the ratio of sum of the products of the number of credits (C) of courses registered and the corresponding grade points (GP) scored in those courses, taken for all the courses and sum of the number of credits of all the courses.

$$GPA = \left(Sum\ of\ \left(C \times GP\right) / Sum\ of\ C\right)$$

CGPA will be calculated in a similar manner, considering all the courses enrolled from first semester. FA grades are to be excluded for calculating

GPA and CGPA. The conversion of CGPA into percentage marks is as given below.

$$\%\ Marks = (CGPA - 0.5) \times 10$$

12. Award of Class and Rank:

(i)A candidate who satisfies the course requirements for all semesters and who passes all the examinations prescribed for all the eight semesters (six semesters for lateral entry candidates) within a maximum period of 7 years (6 years for lateral entry candidates) reckoned from the commencement of the first semester to which the candidate was admitted shall be declared to have qualified for the award of degree.

(ii) A candidate who qualifies for the award of the degree passing in all subjects pertaining to semesters 3 to 8 in his/her first appearance within 6 consecutive semesters (3 academic years) and in addition secures a CGPA of 8.50 and above for the semesters 3 to 8 shall be declared to have passed the examination in **FIRST CLASS** with **DISTINCTION**.

(iii) A candidate who qualifies for the award of the degree by passing in all subjects relating to semesters 3 to 8 within a maximum period of eight semesters after his/her commencement of study in the third semester and in addition secures CGPA not less than 6.5 shall declared to have passed the examination in **FIRST CLASS**.

(iv) All other candidates who qualify for the award of degree shall be declared to have passed the examination in **SECOND CLASS**.

(v) For the Award of University ranks and Gold Medal for each branch of study, the CGPA secured from 1^{st} to 8^{th} semester alone should be considered and it is mandatory that the candidate should have passed all the subjects from 1^{st} to 8^{th} semester in the first attempt. Rank certificates would be issued to the first ten candidates in each branch of study.

13. Provision for withdrawal:

A candidate may, for valid reasons, and on the recommendation of the Head of the Institution, be granted permission by the University to withdraw from writing the entire semester examination as one Unit. The withdrawal application shall be valid only if it is made earlier than the commencement of the last theory examination pertaining to that semester. Withdrawal shall be permitted only once during the entire course. Other conditions being satisfactory, candidates who withdraw are also eligible to be awarded DISTINCTION whereas they are not eligible to be awarded a rank.

14. Discontinuation of course:

If a candidate wishes to temporarily discontinue the course for valid reasons, he/she shall apply through the Head of the Institution in advance and obtain a written order from the University permitting discontinuance. A candidate after temporary discontinuance may rejoin the course only at the commencement of the semester at which he/she discontinued, provided he/she pays the

prescribed fees to the University. The total period of completion of the course reckoned from the commencement of the first semester to which the candidate was admitted shall not in any case, exceed 7 years, including of the period of discontinuance.

15. Revision of Regulations and Curriculum:

The University may from time to time revise, amend or change the regulations of curriculum and syllabus as and when found necessary.

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ANNEXURE-A

B.Tech courses in which admission is sought	Diploma courses eligible for admission
CIVIL ENGINEERING	Civil Engineering Civil and Rural Engineering Architectural Assistantship Architecture Agricultural Engineering
MECHANICAL ENGINEERING	Mechanical Engineering Automobile Engineering Agricultural Engineering Mechanical and Rural Engineering Refrigeration and Air-conditioning Agricultural Engineering & Farm Equipment Technology Metallurgy Production Engineering Machine Design & Drafting Machine Tool Maintenance and Repairs Printing Technology / Engineering Textile Engineering / Technology Tool Engineering Mechatronics Plastics and Moulding Technology
ELECTRICAL AND ELECTRONICS ENGINEERING **ELECTRONICS & COMMUNICATION ENGINEERING** **ELECTRONIC AND INSTRUMENTATION ENGINEERING** **INSTRUMENTATION AND CONTROL ENGINEERING** **BIO MEDICAL ENGINEERING**	Electrical Engineering Electrical and Electronics Engineering Electronics and Instrumentation Engineering Instrumentation Engineering / Technology Electronics and Communication Engineering Electronics Engineering Medical Electronics Instrumentation and Control Engineering Applied Electronics
CHEMICAL ENGINEERING	Chemical Engineering Chemical Technology Petrochemical Technology Petroleum Engineering Ceramic Technology Plastic Engineering Paper & pulp Technology/Polymer Technology
INFORMATION TECHNOLOGY **COMPUTER SCIENCE & ENGINEERING**	Computer Science and Engineering Computer Technology Electrical and Electronics Engineering Electronics & Communication Engineering Electronics & Instrumentation Engineering Instrumentation Engineering / Technology Information Technology

PONDICHERRY UNIVERSITY

B.Tech – CURRICULUM & SYLLABUS

MECHANICAL ENGINEERING

I Semester

S. No.	Subject Code	Subjects	Periods			Credits	Marks		
			L	T	P		IA	UE	TM
Theory									
01	T101	Mathematics – I	3	1	0	04	25	75	100
02	T102	Physics	4	0	0	04	25	75	100
03	T103	Chemistry	4	0	0	04	25	75	100
04	T104	Basic Electrical and Electronics Engineering	3	1	0	04	25	75	100
05	T105	Engineering Thermodynamics	3	1	0	04	25	75	100
06	T106	Computer Programming	3	1	0	04	25	75	100
Practical									
07	P101	Computer Programming Lab	0	0	3	02	50	50	100
08	P102	Engineering Graphics	2	0	3	02	50	50	100
09	P103	Basic Electrical and Electronics Lab	0	0	3	02	50	50	100
Total			**22**	**4**	**9**	**30**	**300**	**600**	**900**

II Semester

S. No.	Subject Code	Subjects	Periods			Credits	Marks		
			L	T	P		IA	UE	TM
Theory									
01	T107	Mathematics – II	3	1	0	04	25	75	100
02	T108	Material Science	4	0	0	04	25	75	100
03	T109	Environmental Science	4	0	0	04	25	75	100
04	T110	Basic Civil and Mechanical Engineering	4	0	0	04	25	75	100
05	T111	Engineering Mechanics	3	1	0	04	25	75	100
06	T112	Communicative English	4	0	0	04	25	75	100
Practical									
07	P104	Physics Laboratory	0	0	3	02	50	50	100
08	P105	Chemistry Laboratory	0	0	3	02	50	50	100
09	P106	Workshop Practice	0	0	3	02	50	50	100
10	P107	NSS/NCC*	-	-	-	-	-	-	-
Total			**22**	**2**	**9**	**30**	**300**	**600**	**900**

* *To be completed in I & II semesters, under Pass/Fail option only and not counted for CGPA calculation.*

PONDICHERRY UNIVERSITY

B.Tech (Mechanical Engineering)
CURRICULUM AND SYLLABUS – III TO VIII SEMESTER

III Semester

S. No.	Subject Code	Subjects	Periods			Credits	Marks		
			L	T	P		IA	UE	TM
Theory									
01	MAT31	Mathematics – III	3	1	0	04	25	75	100
02	MET31	Mechanics of Solids	3	1	0	04	25	75	100
03	MET32	Mechanics of Fluids	3	1	0	04	25	75	100
04	MET33	Applied Thermodynamics	3	1	0	04	25	75	100
05	MET34	Manufacturing Processes	4	0	0	04	25	75	100
06	MET35	Electrical and Electronics Engineering	3	1	0	04	25	75	100
Practical									
07	MEP31	Material Testing and Metallurgy Lab	0	0	3	02	50	50	100
08	MEP32	Manufacturing Processes Lab - I	0	0	3	02	50	50	100
09	MEP33	Electrical and Electronics Lab	0	0	3	02	50	50	100
Total			**19**	**5**	**9**	**30**	**300**	**600**	**900**

IV Semester

S. No.	Subject Code	Subjects	Periods			Credits	Marks		
			L	T	P		IA	UE	TM
Theory									
01	MAT41	Mathematics – IV	3	1	0	04	25	75	100
02	MET41	Engineering Metallurgy	4	0	0	04	25	75	100
03	MET42	Fluid Machinery	3	1	0	04	25	75	100
04	MET43	Kinematics of Machinery	3	1	0	04	25	75	100
05	MET44	Machine Drawing	2	0	3	04	50	50	100
06	MET45	Machining Processes	4	0	0	04	25	75	100
Practical									
07	MEP41	Fluid Mechanics and Machinery Lab	0	0	3	02	50	50	100
08	MEP42	Manufacturing Processes Lab - II	0	0	3	02	50	50	100
09	MEP43	Computer Aided Machine Drawing Lab	0	0	3	02	50	50	100
10	MEP44	Physical Education				--			
Total			**19**	**3**	**12**	**30**	**300**	**600**	**900**

V Semester

S. No.	Subject Code	Subjects	Periods			Credits	Marks		
			L	T	P		IA	UE	TM
Theory									
01	MET51	Dynamics of Machinery	3	1	0	04	25	75	100
02	MET52	Design of Machine Elements	3	1	0	04	25	75	100
03	MET53	Metrology and Quality Control	4	0	0	04	25	75	100
04	MET54	Heat and Mass Transfer	3	1	0	04	25	75	100
05	MET55	Mechanical Measurements	3	1	0	04	25	75	100
06		Elective - I	4	0	0	03	25	75	100
Practical									
07	MEP51	Manufacturing Process Lab - III	0	0	3	02	50	50	100
08	MEP52	Mechanical Measurement and Metrology Lab	0	0	3	02	50	50	100
09	MEP53	Computational Methods Lab	2	0	2	02	50	50	100
10	MEP54	General Proficiency - I	0	0	3	01	100	--	100
Total			**20**	**4**	**12**	**30**	**400**	**600**	**1000**

VI Semester

S. No.	Subject Code	Subjects	Periods			Credits	Marks		
			L	T	P		IA	UE	TM
Theory									
01	MET61	Operations Research	3	1	0	04	25	75	100
02	MET62	Design of Transmission Systems	3	1	0	04	25	75	100
03	MET63	Thermal Engineering	3	1	0	04	25	75	100
04	MET64	Computer Integrated Manufacturing	4	0	0	04	25	75	100
05	MET65	Control System Engineering	3	1	0	04	25	75	100
06		Elective - II	3	1	0	03	25	75	100
Practical									
07	MEP61	Thermal Engineering Lab - I	0	0	3	02	50	50	100
08	MEP62	Dynamics of Machine Lab	0	0	3	02	50	50	100
09	MEP63	Computational Fluid Dynamics Lab	0	0	3	02	50	50	100
10	MEP64	General Proficiency - II	0	0	3	01	100	--	100
Total			**19**	**5**	**12**	**30**	**400**	**600**	**1000**

VII Semester

S. No.	Subject Code	Subjects	Periods			Credits	Marks		
			L	T	P		IA	UE	TM
Theory									
01	MET71	Computer Aided Design	3	1	0	04	25	75	100
02	MET72	Industrial Engineering and Management	4	0	0	04	25	75	100
03	MET73	Refrigeration, Air Conditioning and Cryogenic Engineering	3	1	0	04	25	75	100
04		Elective - III	3	1	0	03	25	75	100
Practical									
05	MEP71	Thermal Engineering Lab - II	0	0	3	02	50	50	100
06	MEP72	Computer Aided Engineering Lab	0	0	3	02	50	50	100
07	MEP73	Comprehensive Viva - Voce	0	0	3	01	50	50	100
08	MEP74	Industrial Visit/Training Report	-	-	-	01	100	-	100
09	MEPW7	Project Work(Phase I)	-	-	3	04	50	50	100
Total			**13**	**3**	**12**	**25**	**400**	**500**	**900**

VIII Semester

S. No.	Subject Code	Subjects	Periods			Credits	Marks		
			L	T	P		IA	UE	TM
Theory									
01	MET81	Power Plant Engineering	3	1	0	04	25	75	100
02	MET82	Professional Ethics and Indian Constitution	1	0	0	01	100	--	100
03		Elective - IV	3	1	0	03	25	75	100
04		Elective - V	3	1	0	03	25	75	100
Practical									
05	MEPW8	Project Work (Phase II)**	0	0	12	08	50**	50	100
06	MEP81	Seminar	0	0	3	01	100	--	100
Total			**10**	**3**	**15**	**20**	**325**	**275**	**600**

LIST OF ELECTIVES

SUBJECT CODE	SUBJECTS
	Elective – I
MEE51	Computational Methods and Programming
MEE52	Direct Energy Conversion Systems
MEE53	Engineering Tribology
MEE54	Industrial Casting Technology
MEE55	Nuclear Power Engineering
	Elective – II
MEE61	Automobile Engineering
MEE62	Computational Fluid Dynamics
MEE63	Finite Element Methods
MEE64	Industrial Automation
MEE65	Mechatronics
MEE66	Nano Technology
MEE67	Theory of Metal Cutting
	Elective – III
MEE71	Energy and Environmental Management
MEE72	Industrial Robotics
MEE73	Integrated Materials Management
MEE74	Metal Forming Processes
MEE75	Product Design and Development
MEE76	Solar Power Engineering
	Elective – IV and V
MEE81	Advanced Welding Techniques
MEE82	Automotive Fuels, Pollution and Control
MEE83	Composite Materials
MEE84	Fluid Power Automation
MEE85	Maintenance and Safety Engineering
MEE86	MEMS and Micro - Nano Fluids
MEE87	Project Management
MEE88	Robust Design
MEE89	System Design and Optimization in Thermal Engineering
MEE810	Total Quality Management

T101 MATHEMATICS – I

OBJECTIVES

- *To introduce the idea of applying calculus concepts to problems in engineering.*
- *To familiarize the student with functions of several variables.*
- *To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.*
- *To introduce effective mathematical tools for the solutions of differential equations that model physical processes.*

UNIT I – CALCULUS

Curvature, radius of curvature, evolutes and involutes. Beta and Gamma functions and their properties.

UNIT II – FUNCTIONS OF SEVERAL VARIABLES

Partial derivatives, Total derivatives, Differentiation of implicit functions, Change of variables, Jacobians and their properties, Taylor's series for functions of two variables, Maxima and Minima, Lagrange's method of undetermined multipliers.

UNIT III - MULTIPLE INTEGRALS AND APPLICATIONS

Multiple integrals, change of order of integration and change of variables in double integrals (Cartesian to polar). Applications: Areas by double integration and volumes by triple integration (Cartesian and polar).

UNIT IV - DIFFERENTIAL EQUATIONS

Exact equations, First order linear equations, Bernoulli's equation, orthogonal trajectories, growth, decay and geometrical applications. Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

UNIT V - DIFFERENTIAL EQUATIONS (HIGHER ORDER)

Linear differential equations of higher order – with constant coefficients, the operator D, Euler's linear equation of higher order with variable coefficients, simultaneous linear differential equations, solution by variation of parameters method – simple application to electric circuits.

Text Books:

1. Venkatraman M.K, Engineering Mathematics – First year, National publishing company, Chennai, 2010.(For Units I,III,IV &V only)
2. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 41st Edition, 2011. (For Unit II only)

Reference Books

1. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
2. Kandasamy P. et al, Engineering Mathematics, Vol.1 & 2,S. Chand & Co., New Delhi.
3. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010
4. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & sons, New Delhi, 8th Edition.
5. Bali N. and Goyal M., Advanced Engineering Mathematics, Lakshmi Publications Pvt. Ltd., New Delhi, 7th Edition, 2010.

T102 PHYSICS

OBJECTIVES:

- *To understand the concepts of physics and its significant contributions in the advancement of technology and invention of new products that dramatically transformed modern-day society.*
- *To expose the students to different areas of physics which have direct relevance and applications to different Engineering disciplines*
- *To understand the concepts and applications of Ultrasonics, optics and some optical devices, Laser and Fiber optics, Nuclear energy sources and wave mechanics*

UNIT I – ACOUSTICS & NDT

Ultrasonics – Ultrasonic Waves productions (piezoelectric & Magnetostriction method) - Detections (Acoustic Grating) NDT applications – Ultrasonic pulse echo Method - liquid penetrant Method

Acoustics - Factors affecting Acoustic of buildings (Reverberation, Loudness, Focusing, Echo, Echelon Effect and Resonance) and their Remedies – Sabine's formula for Reverberation Time – Doppler effect and its applications to Radars. (elementary ideas)

UNIT II – OPTICS

Interference - Air wedge – Michelson's Interferometer - wavelength determination –Interference Filter – Antireflection Coatings

Diffraction - Diffraction Grating – Dispersive power of grating – Resolving power of grating & Prism

Polarization - Basic concepts of double refraction – Huygens Theory of Double Refraction – Quarter and Half Wave Plates – Specific Rotary Power – Laurent Half Shade Polarimeter.

UNIT III – LASERS & FIBER OPTICS

Lasers - Principles of Laser – Spontaneous and Stimulated Emissions – Einstein's Coefficients – Population Inversion and Laser Action – types of Optical resonators(qualitative ideas) – Types of Lasers - NdYAG, CO_2 laser, GaAs Laser- applications of lasers

Fiber Optics - Principle and Propagation of light in optical fiber – Numerical aperture and acceptance angle – Types of optical fibers (material, refractive index, mode) – applications to sensors and Fiber Optics Communication

UNIT IV – WAVE MECHANICS

Matter Waves – de Broglie Wavelength – Uncertainty Principle – Schrodinger Wave Equation – Time Dependent – Time Independent – Application to Particle in a One Dimensional Potential Box – Quantum Mechanical Tunneling – Tunnel Diode.

UNIT V – NUCLEAR ENERGY SOURCE

General Properties of Nucleus (Size, Mass, Density, Charge) – Mass Defect – Binding Energy - Disintegration in fission – *Nuclear Reactor:* Materials Used in Nuclear Reactors. – PWR –BWR – FBTR. Nuclear fusion reactions for fusion reactors - D-D and D-T reactions, Basic principles of Nuclear fusion reactors.

Text Books:

1. V Rajendran, Engineering Physics, 2nd Edition TMH, New Delhi 2011 (For Units I to IV only)
2. Arthur Beiser, Concepts of Modern Physics, 6th Edition, TMH, New Delhi reprinted 2008. (For Unit V only)

Reference Books:

1. Ajay Ghatak, Optics, 5th Edition TMH, New Delhi, 2012.
2. K. Thyagarajan and Ajoy Ghatak, Laser Fundamentals and Applications, 2nd Edition, Springer 2010.
3. R. Murugesan, Modern Physics, S. Chand & Co, New Delhi 2006.
4. K.R.Nambiar, Laser, New Age International, New Delhi, 2008.
5. Science of Engineering Materials, 2nd Edition, C.M. Srivastava and C. Srinivasan, New Age Int. (P) Ltd, New Delhi, 1997.
6. Avadhanulu M N, Engineering Physics, Vol-1, S. Chand & Co, 2009.

T103 CHEMISTRY

OBJECTIVES

- *To know about the importance of Chemistry in Engineering domain*
- *To understand the chemistry background of industrial process*
- *To apply chemistry knowledge for Engineering disciplines*

UNIT I – WATER (9 Hours)

Hardness of water – units and calcium carbonate equivalent. Determination of hardness of water- EDTA method. Disadvantages of hardwater-boiler scale and sludge, caustic embrittlement, priming & foaming and boiler corrosion. Water softening method – internal & external conditioning – lime-soda process, zeolite process and ion exchange process. Desalination – reverse osmosis & electrodialysis.

UNIT II – POLYMERS (9 Hours)

Classification, types of polymerization reactions – mechanism of radical, ionic and Ziegler-Natta polymerizations. Polymer properties – Chemical resistance, crystallinity and effect of temperature, M_n and M_w. Thermoplastics and thermosets. Preparation, properties and uses of PVC, TEFLON, Nylons, Bakelite, Polyurithane, rubber – vulcanization, synthetic rubber, BuNa-S, BuNa-N, Silicone and butyl rubber. Conducting Polymers – classification and applications. Polymer composites – FRP – laminar composites. Moulding constituents of plastics, moulding techniques – compression, injection, transfer and extrusion moulding.

UNIT III – ELECTROCHEMICAL CELLS (9 Hours)

Galvanic cell, single electrode potential, standard electrode potential, electromotive series. EMF of a cell and its measurement. Nernst equation. Electrolyte concentration cell. Reference electrodes - hydrogen, calomel, Ag/AgCl & glass electrodes. Batteries - primary and secondary cells, Leclanche cell, Lead acid storage cell, Ni-Cd battery & alkaline battery. Fuel cells – H_2-O_2 fuel cell.

UNIT IV – CORROSION AND ITS CONTROL (9 Hours)

Chemical & electrochemical corrosion-Galvanic, pitting, stress and concentration cell corrosion. Factors influencing corrosion-corrosion control methods - cathodic protection and corrosion inhibitors. Protective coating - types of protective Coatings - metallic coating - tinning and galvanizing, cladding, electroplating and anodizing.

UNIT V - PHASE RULE (9 Hours)

Definition and derivation of phase rule. Application to one component system - water and sulphur systems. Thermal analysis, condensed phase rule. Two component systems – Pb - Ag, Cu-Ni and Mg-Zn systems.

Text books:

1. P.C. Jain and Monika Jain, Engineering Chemistry, Dhanpat Rai and Sons, New Delhi 15th Ed, 2010.

Reference Books:

1. S. S. Dara, A Textbook of Engineering Chemistry, 11th Ed, S. Chand & Co., Ltd. New Delhi, 2008.
2. B. K. Sharma, Engineering Chemistry, 3rd edition Krishna Prakashan Media (P) Ltd., Meerut, 2001.
3. P. Kannan and A. Ravi Krishnan “Engineering Chemistry” Hi-Tech Sri Krishna Publications, Chennai, 9th Ed, 2009.
4. N. Krishnamurthy, P. Vallinayagam and D. Madhavan, Engineering Chemistry, 2nd Ed, PHI Learning PVT., LTD, New Delhi, 2008.

T104 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

OBJECTIVES

- *To understand and gain basic knowledge about magnetic and electrical circuits, single phase and three phase power measurement and the operating principles of stationary and rotating machines*
- *To understand the basic operation, functions and applications of PN junction diode, transistor, logic gates and flip flops.*
- *To gain knowledge on various communication systems and network models and the use of ISDN*

PART A – ELECTRICAL

UNIT I - DC CIRCUITS

Definition of Voltage, Current, Power & Energy, circuit parameters, Ohm's law, Kirchhoff's law & its applications – simple problems – division of Current in series & parallel circuits – star/delta conversion – node and mesh methods of analysis of DC circuits.

UNIT II - AC CIRCUITS

Concepts of AC circuits – rms value, average value, form and peak factors – simple RLC series circuits – concept of real and reactive power – power factor – introduction to three phase system – power measurement by two wattmeter method

UNIT III - ELECTRICAL MACHINES AND POWER PLANTS

Law of Electromagnetic induction, Fleming's Right & Left hand rule – Principle of DC rotating machine, Single Phase transformer and single phase induction motor (Qualitative approach only) – simple layout of thermal and hydro generation (block diagram approach only). Fundamentals of fuses and circuit breakers

PART B – ELECTRONICS

UNIT – IV ELECTRONIC CIRCUITS

V-I characteristics of diode – Half-wave rectifier and full-wave rectifier – with and without capacitor filter – Transistor – Construction & working – input and output characteristics of CB and CE configuration – Transistor as an Amplifier – Principle and working of Hartley oscillator and RC phase shift oscillator – Construction and working of JFET & MOSFET.

UNIT– V DIGITAL ELECTRONICS

Boolean algebra – reduction of Boolean expressions – De-Morgan's theorem – Logic gates – Implementation of Boolean expressions – Flip flops – RS, JK, T and D. Combinational logic – Half adder, Full adder and Subtractors. Sequential logic – Ripple counters and shift registers.

UNIT– VI COMMUNICATION AND COMPUTER SYSTEMS

Model of communication system – Analog and digital – Wired and wireless channel. Block diagram of various communication systems – Microwave, satellite, optical fiber and cellular mobile system.
Network model – PAN, LAN, MAN and WAN – Circuit and packet switching – Overview of ISDN.

Text Books:

1. Kothari D P and Nagrath I J, Basic Electrical Engineering, Tata McGraw Hill, 2009. (For Units I to III)
2. Rajendra Prasad , “Fundamentals of Electronic Engineering”, Cengage learning, New Delhi, first Edition, 2011 (For Unit IV)
3. Morris Mano, “Digital Design”, PHI learning, Fourth Edition, 2008 (For Unit V)
4. Wayne Tomasi, “Electronic Communication Systems-Fundamentals Theory Advanced”, Sixth Edition, Pearson Education, 2004.(For Unit VI)

Reference Books:

1. R. Muthusubramaniam, S.Salivahanan and K.A. Mureleedharan, Basic Electrical Electronics and Computer Engineering, Tata McGraw Hill, 2004.
2. J.B.Gupta, A Course in Electrical Power, Katson Publishing House, New Delhi, 1993.
3. David.A Bell, “Electronic Devices and Circuits”, PHI Learning Private Ltd, India Fourth Edition, 2008.
4. Donald P Leach, Albert Paul Malvino and Goutam Saha, “digital Principles and Applications” 6^{th} edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2008.
5. S.K. Sahdev, Fundamentals of Electrical Engineering and Electronics, Dhanpat Rai & Co, 2013.
6. Jacob Millman and Christos C. Halkias, “Electronic Devices and Circuits” Tata McGraw Hill, 2008.
7. R.L. Boylestad and L. Nashelsky, “Electronic Devices and Circuit Theory”, PHI Learning Private Limited, Ninth edition, 2008.
8. M.S.Sukhija and T.K. Nagsarkar, “Basic Electrical and Electronics Engineering”, Oxford University Press, 2012.

T105 ENGINEERING THERMODYNAMICS

OBJECTIVES

- *To understand the basics of the thermodynamic principles*
- *To establish the relationship of these principles to thermal system behaviors*
- *To develop methodologies for predicting the system behavior*
- *To establish the importance of laws of thermodynamics applied to energy systems*
- *To explain the role of refrigeration and heat pump as energy systems*
- *To develop an intuitive understanding of underlying physical mechanism and a mastery of solving practical problems in real world*

UNIT I – BASIC CONCEPTS AND DEFINITIONS

Energy conversion and efficiencies - system, property and state – Thermal equilibrium – Temperature – Zeroth law of Thermodynamics – Pure substance – P, V and T diagrams – Thermodynamic diagrams.

UNIT II – FIRST LAW OF THERMODYNAMICS

The concept of work and adiabatic process – First law of thermodynamics – conservation of Energy Principle for closed and open systems – Calculation of work for different processes of expansion of gases

UNIT III – SECOND LAW OF THERMODYNAMICS

Equilibrium and the second law – Heat engines – Kelvin-Plank statement of second law of thermodynamics – Reversible and irreversible processes – Carnot principle – Clausius inequality – Entropy

UNIT IV – GAS POWER CYCLES

Air standard cycles: The air standard carnot cycle – Air standard Otto cycle, Diesel cycle, Dual cycle and Brayton cycles and their efficiencies

UNIT V – REFRIGERATION CYCLES AND SYSTEMS

Reverse Carnot cycle – COP – Vapor compression refrigeration cycle and systems (only theory) – Gas refrigeration cycle – Absorption refrigeration system – Liquefaction – Solidification (only theory).

Text Books:

1. Nag, P.K., “Engineering Thermodynamics”, 4th edition, Tata Mc-Graw Hill Publishing Co. Ltd., New Delhi, 2008.

Reference Books:

1. Arora, C.P., “Thermodynamics”, Tata Mc-Graw Hill Publishing Co. Ltd., New Delhi, 2010.
2. Burghardt, M.D., “Engineering Thermodynamics with Applications”, 4th edition, Harper & Row, N.Y., 2009.
3. Huang, F.F., “Engineering Thermodynamics” 2nd edition, Macmillan Publishing Co. Ltd., N.Y., 2011.
4. Cengel, Y.A. and Boles, M.A., “Thermodynamics – An Engineering approach”, 5th edition, Mc Graw Hill, 2008.
5. Wark, K., “Thermodynamics”, 4th edition Mc-Graw Hill, N.Y., 2009.

T106 COMPUTER PROGRAMMING

OBJECTIVES

- *To introduce the basics of computers and information technology.*
- *To educate problem solving techniques.*
- *To impart programming skills in C language.*
- *To practice structured programming to solve real life problems.*

UNIT – I

History of computers – Block diagram of a computer – Components of a computer system – Classification of computers – Hardware – Software – Categories of Software – Operating System – Applications of Computers – Network structure – Internet and its services – Intranet – Study of word processor – Preparation of worksheets.

UNIT – II

Problem solving techniques – Program – Program development cycle – Algorithm design – Flowchart – Pseudo code.
Introduction to C – History of C – Importance of C – C tokens – Data types – Operators and expressions – I/O functions.

UNIT – III

Decision making statements – branching and looping – arrays – multidimensional arrays – Functions – Recursion – Passing array to functions. Storage classes – Strings – String library functions.

UNIT – IV

Structures – Arrays and structures – nested structures – passing structures to functions – user defined date types – Union.
Pointers – pointers and arrays – pointers and functions – pointer and strings – pointer and structures.

UNIT – V

Files – operations on a file – Random access to files – command line arguments. Introduction to preprocessor – Macro substitution directives – File inclusion directives – conditional compilation directives – Miscellaneous directives.

Text Books:

1. Balagurusamy. E, “Programming in ANSI C”, Tata Mc-Graw Hill, sixth edition, 2012.

Reference Books:

1. Vikas verma, “A Workbook on C”, Cengage Learning, Second Edition, 2012
2. Ashok N Kamthane, “Computer Programming”, Pearson education, second Impression, 2008.

P101 COMPUTER PROGRAMMING LAB

OBJECTIVES

- *To study and understand the use of OS commands*
- *To gain a hands on experience of compilation and execution of 'C' programs*

LIST OF EXERCISES:

1. Study of OS Commands
2. Write a C program to find the area of Triangle.
3. Write a C program to find the total and average percentage obtained by a student of 6 subjects.
4. Write a C program to read a three digit number and produce output like
   1 hundreds
   7 tens
   2 units
   for an input of 172.
5. Write a C program to check whether a given character is vowel or not using switch – Case statement.
6. Write a C program to print the number from 1 to 10 along with their squares.
7. Write a C program to find the sum of 'n' numbers using for, do – while statements.
8. Write a C program to find the factorial of a given number using Functions.
9. Write a C program to swap two numbers using call by value and call by reference.
10. Write a C program to find the smallest and largest element in an array.
11. Write a C program to perform matrix multiplication.
12. Write a C program to demonstrate the usage of local and Global variables.
13. Write a C program to perform various string handling functions: strlen, strcpy, strcat, strcmp.
14. Write a C program to remove all characters in a string except alphabets.
15. Write a C program to find the sum of an integer array using pointers.
16. Write a C program to find the Maximum element in an integer array using pointers.
17. Write a C program to create student details using Structures.
18. Write a C program to display the contents of the file on the monitor screen.
19. Create a file by getting the input from the keyboard and retrieve the contents of the file using file operation commands.
20. Write a C program to pass the parameter using command line arguments.

P102 ENGINEERING GRAPHICS

OBJECTIVES

- *To convey the basics of engineering drawing*
- *To explain the importance of an engineering drawing*
- *To teach different methods of making the drawing*
- *To establish the importance of projects and developments mode in drawing that are used in real systems*
- *To explain the role of computer aided design_ Auto Cad*
- *To develop an intuitive understanding of underlying significance of using these drawings*

UNIT

Introduction to Standards for Engineering Drawing practice, Lettering, Line work and Dimensioning

UNIT I

Conic sections, Involutes, Spirals, Helix. Projection of Points, Lines and planes

UNIT II

Projection of Solids and Sections of solids.

UNIT III

Development of surfaces – Intersection of surfaces (Cylinder-Cylinder, cylinder-cone)

UNIT IV

Isometric projections and Orthographic projections

UNIT V

Computer Aided Drafting: Introduction to computer Aided Drafting hardware-overview of application software – 2D drafting commands (Auto CAD) for simple shapes – Dimensioning.

Text Books:

1. K.R. Gopalakrishna and Sudhir Gopalakrishna, Engineering Graphics, Inzinc Publishers, 2007.

Reference Books:

1. N.D. Bhatt, Engineering Drawing, 49th edition, Chorotar Publishing House, 2006.
2. K. Venugopal, Engineering Drawing and Graphics + Auto CAD, 4th edition, New Age International Publication Ltd., 2004.
3. David I cook and Robert N Mc Dougal, Engineering Graphics and Design with computer applications, Holt – Sounders Int. Edn. 1985.
4. James D Bethune and et. al., Modern Drafting, Prentice Hall Int., 1989.

5. K.V. Natarajan, A Text Book of Engineering Drawing, Dhanalakshmi Publishers, 2006.
6. BIS, Engineering Drawing practice for Schools & Colleges, 1992.

P103 BASIC ELECTRICAL AND ELECTRONIC LAB

OBJECTIVES

- *To get an exposure on the basic electrical tools, applications and precautions*
- *To gain training on different types of wiring used in domestic and industrial applications*
- *To detect and find faults in electrical lamp and ceiling fan*
- *To get an exposure on the measurements of voltage and phase using CRO, basic operation and applications of devices such as PN junctions diode and transistor*
- *To gain a practical knowledge on the functions and applications of basic logic gates and flip flops*

ELECTRICAL LAB

LIST OF EXPERIMENTS

1. Electrical Safety, precautions, study of tools and accessories.
2. Practices of different joints.
3. Wiring and testing of series and parallel lamp circuits.
4. Staircase wiring.
5. Doctor's room wiring.
6. Bed room wiring
7. Godown wiring.
8. Wiring and testing a ceiling fan and fluorescent lamp circuit.
9. Study of different types of fuses, circuits breakers and A.C and D.C meters

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ELECTRONICS LAB

LIST OF EXPERIMENTS

1. **Study of CRO.**
   (a) Measurement of AC and DC voltages
   (b) Frequency and phase measurements (using Lissajou's figures)

2. **Verification of Kirchhoff' s Voltage and Current Laws**
   Determine the voltage and current in given circuits using Kirchhoff's laws theoretically and verify the laws experimentally.

3. **Characteristics and applications of PN junction diode.**
   Forward and Reverse characteristics of PN junction diode.
   Application of diode as Half wave Rectifier – Measurement of ripple factor with and without capacitor filter.

4. **Frequency response of RC Coupled Amplifiers.**

   Determination of frequency response of given RC coupled amplifier- Calculation of bandwidth.

5. **Study of logic gates.**

   a) Verification of Demorgan's theorems.

   b) Verification of truth tables of OR, AND, NOT, NAND, NOR, EX-OR, EX-NOR gates and flip-flops – JK, RS, T and D

   c) Implementation of digital functions using logic gates and universal gates.

T107 MATHEMATICS – II

OBJECTIVES

- *To develop the use of matrix algebra techniques for practical applications.*
- *To introduce the concepts of Curl, Divergence and integration of vectors in vector calculus which is needed for many application problems.*
- *To introduce Laplace transform which is a useful technique in solving many application problems and to solve differential and integral equations.*
- *To acquaint the students with Fourier transform techniques used in wide variety of situations in which the functions used are not periodic.*

UNIT I- MATRICES

Eigenvalues and Eigen vectors of a real matrix, characteristic equation, Properties of Eigenvalues and Eigenvectors. Cayley-Hamilton Theorem, Diagonalization of matrices. Reduction of a quadratic form to canonical form by orthogonal transformation. Nature of quadratic forms.

UNIT II- VECTOR CALCULUS

Gradient, divergence and curl, their properties and relations. Gauss divergence theorem and Stoke's theorem (without proof). Simple application problems.

UNIT III- LAPLACE TRANSFORM

Definition, Transforms of elementary functions, properties. Transform of derivatives and integrals. Multiplication by t and division by t. Transform of unit step function, transform of periodic functions. Initial and final value theorems.

UNIT IV- APPLICATIONS OF LAPLACE TRANSFORM

Methods for determining inverse Laplace transforms, convolution theorem, Application to differential equations and integral equations. Evaluation of integral by Laplace transforms.

UNIT V- FOURIER TRANSFORM

Fourier integral theorem (statement only), Fourier transform and its inverse, properties. Fourier sine and cosine transforms, their properties, convolution and Parseval's identity.

Text books:

1. Venkataraman. M. K., Engineering Mathematics, National Publishing Company, Chennai, 2012.
2. Kandasamy P. et al, Engineering Mathematics, vol.2 & 3, S. Chand & Co., New Delhi.

Reference books:

1. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
2. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 41st Edition, 2011.

3. Ramana B.V., Higher Engineering Mathematics, Tata McGraw-Hill, New Delhi, 11th Reprint, 2010.
4. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, New Delhi.
5. Bali N. & Goyal M. Advanced Engineering Mathematics, Lakshmi Publications Pvt. Ltd., New Delhi, 7th Edition, 2010.

T108 MATERIAL SCIENCE

OBJECTIVES

- *To understand the importance of material science as a subject that revolutionized modern day technologies.*
- *To understand the significance of material science in the development of new materials and devices for all branches of engineering.*
- *To impart knowledge to the engineering students about some of the important areas of materials science so as to enable them perceive the significant contributions of the subject in Engineering and Technology.*

UNIT I - CRYSTAL STRUCTURE AND LATTICE DEFECTS

Crystal Structure – Bravais Lattices, Crystal Systems – Coordination Number, Atomic Radius, Packing Factor for FCC & HCP structures – Miller Indices– Powder X Ray Diffraction Method

Lattice defects – Qualitative ideas of point, line, surface and volume defects

UNIT II – DIELECTRIC PROPERTIES

Dielectric Polarization and Mechanism – Temperature dependence of Polarization, Internal or local Field - Clausius-Mossotti relation. Basic ideas of Dielectric loss - frequency dependence of dielectric constant – Measurement of Dielectric constant and loss using Scherring bridge – Elementary ideas of Piezoelectrics, Ferroelectrics and Pyroelectric materials and Applications

UNIT III – MAGNETIC PROPERTIES

Origin of atomic magnetic moment – Bohr magneton - Elementary Ideas of classification of magnetic materials (Dia, Para, Ferro, antiferro & Ferri). – Quantum theory of Para & Ferro Magnetism – Domain Theory of Hysteresis – Heisenberg Theory of Exchange Interaction (without derivation) – Qualitative ideas of Anti ferromagnetic Ordering – Structure and Properties of Ferrites – Properties of Soft & Hard Magnetic Materials – Applications. Magnetic data storage – Magnetic tapes, Hard disks, Magneto optical recording

UNIT IV – SEMICONDUCTORS AND SUPERCONDUCTORS

Semiconductors- Derivation of Carrier concentration in intrinsic Semiconductors – Basic ideas of electrical conductivity in intrinsic and extrinsic semiconductors (without derivation) - temperature dependence of carrier concentration and electrical conductivity in semiconductors (qualitative ideas), Hall effect in semiconductors - Application of Hall Effect, Basic Ideas of Compound Semiconductors (II-VI & III-V)

Superconductivity - Basic concepts – transition temperature – Meissener effect – Type I and II superconductors – high temperature superconductors – 123 superconductor- applications of superconductors.

UNIT V – ADVANCED MATERIALS

Liquid Crystals – Types – Application as Display Devices

Metallic Glasses – preparation by melt spinning. Twin roller system, properties and applications

Shape Memory Alloys **(SMA)**, shape memory effect, properties and applications of SMA.

Nanomaterials- Nano materials (one, two & three dimensional) –Methods of synthesis (PVD,CVD,laser Ablation, Solgel, Ball-milling Techniques), properties and applications of nanomaterials. Carbon nanotubes- synthesis, Properties and applications.

Text books

1. V Rajendran, Engineering Physics, 2nd Edition, TMH, New Delhi 2011.

Reference Books

1. Ali Omar M, Elementary Solid State Physics, Addison Wesley Publishing Co., 2009.
2. William D Callister Jr., Material Science and Engineering, 6th Edition, John Wiley and sons, 2009.
3. Charles Kittel, Introduction to Solid State Physics, 7th edition, John Wiley and sons, Singapore, 2007.
4. V Raghavan, Materials Science and Engineering- A First Course, 5th edition Prentice Hall of India, 2008.
5. B.S Murthy, P. Shankar, Baldev Raj, B.B.Rath, and James Murday, Text book of Nanoscience and Nanotechnology, Universities Press, Hyderabad 2012.
6. M.N. Avadhanulu, Engineering Physics- Volume-II, S.Chand &Co, New Delhi, 2009
7. Pillai S.O, Solid State Physics, 6TH Edition- New Age International, 2005.

T109 ENVIRONMENTAL SCIENCE

OBJECTIVES

- *To know about the environment.*
- *To understand about environmental pollution.*
- *To apply the knowledge in understanding various environmental issues and problems.*

UNIT I – ENVIRONMENT AND ENERGY RESOURCES

Environmental segments – atmosphere, hydrosphere, lithosphere and biosphere. Atmospheric layers. Pollution definition and classification. Pollutants classification. Forest resources - use and over exploitation, deforestation, forest management. Water resources - use and conflicts over water, dams-benefits and problems. Mineral resources - mineral wealth of India, environmental effects of extracting and using mineral resources. Food resources - world food problems, environmental impact of modern Agriculture - fertilizer and pesticides. Energy resources-growing needs, renewable and non-renewable energy resources and use of alternate energy sources. From unsustainable to sustainable development.

UNIT II – ECOSYSTEM AND BIODIVERSITY

Concept of an ecosystem - structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of forest, grassland, desert and aquatic (fresh water, estuarine and marine) ecosystem. Biodiversity - definition-genetic species and ecosystem diversity. Value of biodiversity – consumptive use, productive use, social, ethical, aesthetic and option values. Hot spots of biodiversity. Threats to biodiversity ,habitat loss, poaching of wildlife, human wildlife conflicts. Endangered and endemic species. Conservation of biodiversity – In-situ and ex-situ conservation of biodiversity.

UNIT III - AIR POLLUTION

Definition and classification. Chemical and photochemical reaction in different layers of atmosphere. Causes, sources, effects, and control measures of air pollutants – oxides of Nitrogen, oxides of Carbon, oxides of Sulfur, hydrocarbons, chloro – fluoro carbons and particulates. Mechanism and effects of air pollution phenomenon – Global warming, Ozone Depletion, Acid rain, Sulfurous Smog and Photochemical Smog.

UNIT IV - WATER AND LAND POLLUTION

Water pollution – causes and effects of organic water pollutants – pesticides, insecticides, detergents and surfactants, causes and effects of inorganic water pollutants – heavy metal pollution due to Hg, Pb, Cr, & Cu. Water pollution control and monitoring – DO, COD, BOD & TOC. Land pollution – solid waste management – causes, effect and control measures of urban and industrial wastes. Thermal and radioactive pollution.

UNIT V – POLLUTION CONTROL AND MONITORING

Basic concepts and instrumentation of IR, UV-VIS, atomic absorption spectrometry, Gas Chromatography and Conductometry. Analysis of air pollutants – NO_X, CO_X, SO_X, H_2S, Hydrocarbons and particulates.

Text Books:

1. K. Raghavan Nambiar, "Text Book of Environmental studies" 2nd Ed, Scitech Publications (India) Pvt Ltd, India, 2010 (For Units I & II)
2. A. K. De, "Environmental Chemistry" 7th Ed; New age International (p) Ltd, New Delhi, 2010.(For Units III,IV&V)

Reference Books:

1. B.K. Sharma, "Environmental chemistry" 11th Ed, KRISHNA Prakashan Media (P) Ltd, Meerut, 2007.
2. S.S. Dara, and D.D. Mishra "A text book of environmental chemistry and pollution control, 5th Ed, S.Chand and Company Ltd, New Delhi, 2012.
3. Richard T. Wright, Environmental Science: Toward a sustainable future, 10th edition, Prentice Hall, 2008.
4. G.S. Sodhi, Fundamental concepts of environmental chemistry, I Ed, Alpha Science International Ltd, India, 2000.

T110 BASIC CIVIL AND MECHANICAL ENGINEERING

OBJECTIVES

- *To be able to differentiate the type of buildings according to national building code.*
- *To understand building components and their functions as well as different types of roads, bridges and dams*
- *To explain the concepts of thermal systems used in power plants and narrate the methods of harnessing renewable energies*
- *To explain the role of basic manufacturing processes*
- *To develop an intuitive understanding of underlying working principles of mechanical machines and systems.*

PART –A CIVIL ENGINEERING

UNIT I – BUILDINGS, BUILDING MATERIALS

Buildings-Definition-Classification according to NBC-plinth area, Floor area, carpet area, floor space index-construction materials-stone, brick , cement, cement-mortar, concrete, steel-their properties and uses.

UNIT II – BUILDINGS AND THEIR COMPONENTS

Buildings: Various Components and their functions. Soils and their classification. **Foundation :** function and types. Masonry-function and types. Floors: definition and types of floors. **Roofs:** definition and types.

UNIT III – BASIC INFRASTRUCTURE

Surveying: classification, general principles, types, Uses, instruments used. Roads-types: components, types and their advantage and disadvantages. Bridges: components and types of bridges. Dams: purpose, types of dams. Water supply-sources and quality requirements, need and principles of rainwater harvesting.

PART- B MECHANICAL ENGINEERING

UNIT – IV INTERNAL AND EXTERNAL COMBUSTION SYSTEMS

IC engines – Classification – Working principles – Diesel and petrol engines: two stroke and four stroke engines – Merits and demerits.
Steam generators (Boilers) – Classification – Constructional features (of only low pressure boilers) – Boiler mountings and accessories – Merits and demerits – Applications.

UNIT – V POWER GENERATION SYSTEMS

Conventional and Non-Conventional: Hydraulic – Thermal – Nuclear Power plants – Schemes and layouts (Description only)
Solar – Wind – Geothermal – Wave – Tidal and Ocean Thermal Energy Conversion systems – Basic power plant schemes and layouts (Description only).

UNIT – VI MANUFACTURING PROCESS

Machines – Lathe – Drilling – Bending – Grinding – Shearing (Description only) Machine Process – Turning – Planning – Facing – Blanking – Drilling – Punching – Shearing – Bending – Drawing – Filling – Sawing – Grinding.
Moulding and Metal Joining – Pattern making – Green and dry sand moulding – Arc and Gas welding – Brazing – Soldering (process description only).

Text Books

1. Natarajan, K V, Basic Civil Engineering, 11th edition, Dhanalakshmi publications Chennai, 2011. (For Units I to III)
2. Venugopal , K and Prabhu Raja, Basic Mechanical Engineering, Anuradha Publisher, 2012 (For Units IV to VI)

Reference Books

1. Purushothama Raj.P., Basic civil engineering, 3rd Edn., Dhanam Publications, Chennai, 2001
2. Rajput, R K, Engineering Materials, S Chand & Co. Ltd., New delhi, 2012.
3. Punmia, B.C., et. al., surveying, Vol-1, Laxmi publishers, New Delhi, 2012.
4. Punmia, B.C., et. al., Building Construction, Laxmi publishers, New Delhi, 2012
5. El. Wakil, M.M., Power Plant Technology, Mc Graw Hill Book Co., 1985.
6. Hajra Choudhry, et. al., Workshop Technology Vol I and II, Media promoters publishers Pvt. Ltd., Bombay, 2004.
7. Lindberg, R.A. Process and Materials of Manufacture, PHI, 1999.
8. H.N.Gupta, R.C. Gupta and Arun Mittal, Manufacturing Process, New Age Publications, 2001.
9. Nagpal, Power Plant Engineering, Khanna Publishers, Delhi, 1998.

T111 ENGINEERING MECHANICS

OBJECTIVES

- *To understand the vector and scalar representation of forces and moments, static equilibrium of particles and rigid bodies in two dimensions.*
- *To comprehend the effect of friction on equilibrium*
- *To understand the laws of motion, the kinematics of motion and the interrelationship and to learn to write the dynamic equilibrium equation*
- *To emphasis the concepts through solved examples*

UNIT I – FUNDAMENTAL OF MECHANICS

Basic Concepts Force System and Equilibrium, Definition of force, Moment and Couple, Principle of Transmissibility, Varignon's theorem, Resultant of force system – Concurrent and non concurrent coplanar forces, Condition of static equilibrium for coplanar force system, stability of equilibrium, applications in solving the problems on static equilibrium of bodies.

UNIT II – PRACTICAL APPLICATION OF FORCE SYSTEM

Structural member: Definition, degree of freedom, concept of free body diagrams, types of supports and reactions, types of loads, Analysis of trusses-method of joints, method of sections.
Friction: Introduction, Static dry friction, simple contact friction problems, ladders, wedges.

UNIT III – PROPERTIES OF SURFACES

Properties of sections – area, centroids of lines, areas and volumes, moment of inertia first moment of inertia, second moment of inertia and product of moment of inertia, polar moment of inertia, radius of gyration, mass moment of inertia.

UNIT IV – KINEMATICS AND KINETICS OF PARTICLES

Equations of motion – Rectilinear motion, curvelinear motion, relative motion, D'Alembert's principle, work-Energy equation – conservative forces and principle of conservation of energy, Impulse – momentum, Impact – Direct central impact and oblique central impact

UNIT V – KINEMATICS AND KINETICS OF RIGID BODIES

Plane motion, absolute motion, Relative motion, translating axes and rotating axes, work and energy, impulse and momentum

Text Books

1. Rajesekaran S and Sankara Subramanian., G., Engineering Mechanics, Vikas Publishing House Private Ltd., 2012.

Reference Books

1. Palanichamy, M.S. Nagan, S., Engineering Mechanics – Statics & Dynamics, Tata McGraw-Hill, 2011.
2. Beer, F.P and Johnson Jr. E.R, Vector Mechanics for Engineers, Vol. 1 Statics and Vol.2 Dynamics, McGraw – Hill International Edition, 1997.
3. Bhavikatti,S.S and K.G. Rajashekarappa, Engineering Mechanics, New Age International (p) Ltd, New Delhi, 2010.

T112 COMMUNICATIVE ENGLISH

OBJECTIVES

- *To improve the LSWR skills of I B. Tech students*
- *To instill confidence and enable the students to communicate with ease*
- *To equip the students with the necessary skills and develop their language prowess*

UNIT I – BASIC COMMUNICATION THEORY

Importance of Communication – stages of communication, modes of communication – barriers to communication – strategies for effective communication – Listening: Importance, types, barriers – Developing effective listening skills.

UNIT II – COMPREHENSION AND ANALYSIS

Comprehension of technical and non-technical material – skimming, scanning, inferring-Note making and extension of vocabulary, predicting and responding to context- Intensive Reading and Reviewing

UNIT III – WRITING

Effective sentences, cohesive writing, clarity and conciseness in writing – Introduction to Technical Writing – Better paragraphs, definitions, practice in summary Writing – Four modes of writing – Use of dictionaries, indices, library references – making bibliographical entries with regard to sources from books, journals, internet etc.

UNIT IV- BUSINESS WRITING/CORRESPONDENCE

Report writing – Memoranda – Notice – Instruction – Letters – Resumes – Job applications

UNIT V – ORAL COMMUNICATION

Basics of phonetics – presentation skills – Group discussions – Dialogue writing – Short Extempore – Debates-Role Plays – conversation Practice

Text Book

1. Robert J. Dixson., Complete Course in English, Prentice-Hall of India Pvt. Ltd., New Delhi, 2006.

Reference Books

1. Ashraf M.Rizve., Effective Technical Communication. Tata-McGraw Hill, 2005.
2. Boove, courtland R et al., Business Communication Today. Delhi. Pearson Education, 2002.
3. Meenakshi Raman and Sangeeta Sharma., Technical Communication Principles And Practice, OUP, 2007.
4. Robert J. Dixson., Everday Dialogues in English, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.
5. Sethi, J and Kamalesh Sadanand., A Practical course in English Pronunciation, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.

P104 PHYSICS LABORATORY

OBJECTIVES

- *To provide a practical understanding of some of the concepts learnt in the theory course on physics.*

LIST OF EXPERIMENTS (ANY 10 EXPERIMENTS)

1. Thermal conductivity – Lee's DISC
2. Thermal conductivity – radial flow
3. Spectrometer – Prism or Hollow prism
4. Spectrometer – Transmission grating
5. Spectrometer – Ordinary & Extraordinary rays
6. Newton's rings
7. Air – wedge
8. Half shade polarimeter – determination of specific rotatory power
9. Jolly's experiment – determination of α
10. Magnetism: i-h curve
11. Field along the axis of coil carrying current
12. Vibration magnetometer – calculation of magnetic moment & pole strength
13. Laser experiment: wavelength determination using transmission grating, reflection grating (vernier calipers) & particle size determination
14. Determination of optical absorption coefficient of materials using laser
15. Determination of numerical aperture of an optical fiber
16. Electrical conductivity of semiconductor – two probe / four probe method
17. Hall effect in semiconductor

P105 CHEMISTRY LABORATORY

OBJECTIVES

- *To gain a practical knowledge of Engineering chemistry in relevance to Industrial applications*

LIST OF EXPERIMENTS (ANY 10 EXPERIMENTS)

1. Determination of dissolved oxygen in water.
2. Determination of total hardness of water by EDTA method.
3. Determination of carbonate and bicarbonate in water.
4. Estimation of chloride content in water.
5. Estimation of magnesium by EDTA.
6. Estimation of acetic acid in vinegar.
7. Estimation of ferrous by permanganometry.
8. Estimation of ferrous and ferric iron in a solution mixture by dichrometry.
9. Estimation of available chlorine in bleaching powder.
10. Estimation of copper in copper sulphate solution.
11. Estimation of calcium by permanganometry.
12. Estimation of iron by colorimetry.

DEMONSTRATION EXPERIMENTS (ANY TWO OF THE FOLLOWING)

1. Determination of COD of water sample.
2. Determination of lead by conductometry.
3. Percentage composition of sugar solution by viscometry.

P106 WORKSHOP PRACTICE

OBJECTIVES

- *To convey the basics of mechanical tools used in engineering*
- *To establish hands on experience on the working tools*
- *To develop basic joints and fittings using the hand tools*
- *To establish the importance of joints and fitting in engineering applications*
- *To explain the role of basic workshop in engineering*
- *To develop an intuitive understanding of underlying physical mechanism used in mechanical machines.*

Sl. No.	Trade	List of Exercises
1	Fitting	Study of tools and Machineries. Exercises on symmetric joints and joints with acute angle.
2	Welding	Study of arc and gas welding equipment and tools – Edge preparation – Exercise on lap joint and V Butt joints – Demonstration of gas welding
3	Sheet metal work	Study of tools and Machineries – Exercise on simple products like Office tray and waste collection tray.
4	Carpentry	Study of tools and Machineries – Exercises on Lap joints and Mortise joints

LIST OF EXERCISES

I - FITTING

1. Study of tools and Machineries
2. Symmetric fitting
3. Acute angle fitting

II - WELDING

1. Study of arc and gas welding equipment and tools
2. Simple lap welding (Arc)
3. Single V butt welding (Arc)

III - SHEET METAL WORK

1. Study of tools and machineries
2. Frustum
3. Waste collection tray

IV - CARPENTRY

1. Study of tools and machineries
2. Half lap joint
3. Corner mortise joint.

P107 NCC / NSS

NCC / NSS training is compulsory for all Undergraduate students

1. The above activities will include practical/field activities/Extension lectures.
2. The above activities shall be carried out outside class hours.
3. In the above activities, the student participation shall be for a minimum period of 45 hours.
4. The above activities will be monitored by the respective faculty in-charge and the first Year coordinator.
5. Pass / Fail will be determined on the basis of participation, attendance, performance and behavior. If a candidate fails, he / she has to repeat the course in the subsequent years.
6. Pass in this course is mandatory for the award of degree.

MAT31 MATHEMATICS - III (3 1 0 4)

OBJECTIVES

- *To provide the concepts of functions of a complex variable, conformal mapping, complex integration, series expansion of complex functions, Harmonic analysis and Fourier series.*
- *To make the students understand and work out problems of constructing analytic functions, conformal mapping, bilinear transformation, contour integration and expanding functions into Fourier series including Harmonic analysis.*

UNIT I - FUNCTION OF A COMPLEX VARIABLE

Continuity, derivative and analytic functions – Necessary conditions – Cauchy-Riemann equations (Cartesian and polar form) and sufficient conditions (excluding proof) – Harmonic and orthogonal properties of analytic function – Construction of analytic functions. (09 hours)

UNIT II

Conformal mapping – Simple and standard transformations like $w = z+c$, cz, z^2, e^z, $\sin z$, $\cosh z$ and $z+1/z$ – Bilinear transformation and cross ratio property (excluding Schwarz-Christoffel transformation). Taylor's and Laurent's theorem (without proof) – Series expansion of complex valued functions – classification of singularities. (09 hours)

UNIT III

Complex Integration: Cauchy's integral theorem and its application, Cauchy's integral formula and problems. Residues and evaluation of residues – Cauchy's residue theorem – Contour integration: Cauchy's and Jordan's Lemma (statement only) – Application of residue theorem to evaluate real integrals – unit circle and semicircular contour (excluding poles on boundaries). (09 hours)

UNIT IV

Fourier Series: Dirichlet's conditions – General Fourier series – Expansion of periodic function into Fourier series – Fourier series for odd and even functions – Half-range Fourier cosine and sine series – Change of interval – Related problems. (09 hours)

UNIT V

Root Mean Square Value – Parseval's theorem on Fourier Coefficients. Complex form of Fourier series – Harmonic Analysis. (09 hours)

Text Books:

1. Veerarajan T., Engineering Mathematics for first year, Tata-McGraw Hill, 2010.
2. Venkataraman M.K., Engineering Mathematics, Vol. II & III, National Publishing Company, Chennai, 2012.

Reference Books:

1. Kandasamy P. et al, Engineering Mathematics, Vol. II & III, S. Chand & Co., New Delhi, 2012.
2. Bali N. P and Manish Goyal, Text book of Engineering Mathematics, 3rd Edition, Laxmi Publications (p) Ltd., 2008.
3. Grewal B.S., Higher Engineering Mathematics, 40th Edition, Khanna Publishers, Delhi 2007.
4. Erwin Kreyszig, Advanced Engineering Mathematics, 7Th Edition, Wiley India, (2007).

MET31 MECHANICS OF SOLIDS (3 1 0 4)

OBJECTIVES

- *The course is designed to introduce various behavior of structural components under different loading conditions*
- *To understand the basic concepts of bending of beams and buckling of columns*

UNIT – I

Simple Stresses and Strain – Relation between three modulus and Poisson's ratio – Thermal Stress – Principal stress and Principal planes - Shear Force – Bending Moment – Cantilever and simply supported beams subjected to point loads and uniformly distributed loads. (9 hours)

UNIT – II

Theory of simple bending - stress variation in beam cross Section; Normal and Shear stress in Beams – Beam of uniform strength for bending, combined direct and bending stresses. (9 hours)

UNIT – III

Double integration method – moment area method – Introduction to strain energy method and Principle of virtual work. (9 hours)

UNIT – IV

Torsion of circular solid and Hollow shafts – Shafts in Series and parallel – Combined bending and torsion -Application of Torsion in helical springs: Open and closed coil springs, Leaf Springs. (9 hours)

UNIT – V

Euler's Equation – short and long column, Empirical formulae: Johnson – Rankine. Introduction to thin cylinder – Thick cylinder – Lame's Equation – Compound Cylinders – Interference fit. (9 hours)

Text Books:

1. R K Bansal, Strength of Materials, 4th Edition, Laxmi Publications, New Delhi, 2010
2. R.K.Rajput - Strength of Materials, S.Chand and Company Ltd., New Delhi, 2010**.**
3. Bhavikatti. S. S., Strength of Materials, Vikas Publishing House (P) Ltd., New Delhi, Second Edition, 2008.

Reference Books:

1. U.G.Jindal - Strength of Materials, Galgotia Publication Pvt. Ltd., New Delhi, 1996.

2. Beer F, Jonston E R, DeWolf J, Mechanics of Materials, McGraw-Hill Publications, 2005.

E-learning source:

1. **http://nptel.iitm.ac.in**

MET32 MECHANICS OF FLUIDS (3 1 0 4)

OBJECTIVES

- *To make the students understand the properties of fluid and the concepts of fluid statics, fluid kinematics and fluid dynamics.*
- *To enable them to determine the static forces on surfaces and analyse the stability of submerged and floating bodies*
- *To teach the fundamental laws -mass, momentum and energy equations governing the fluid flow*
- *To make them to analyze various types of flow such as laminar and turbulent flow*
- *To enable the students to determine the friction and other energy loss for various pipes geometries*
- *To enable the students to perform dimensional analysis and identify important parameters and understand the use of similitude and dimensional analysis*
- *To teach the students the concept of boundary layer flow*
- *To teach the students the principle of viscosity, pressure and flow measurement*

UNIT – I

Fluid-properties of fluids–viscosity-Newton's law of viscosity-Types of fluid.
Fluid statics- Fluid pressure- Pascal's law, hydrostatic law- pressure measurement-simple and differential manometers- Hydrostatic forces on plane (horizontal, vertical and inclined) and curved surfaces. Buoyancy – metacentre – metacentric height – stability of submerged and floating bodies. (09 hours)

UNIT – II

Fluid kinematics- Stream lines and path lines-velocity and acceleration- types of fluid flow-flow rate and continuity equation-differential equation of continuity.
Types of motion- velocity potential and stream function- flow net, its characteristics and uses.
Fluid dynamics- Euler's equation of motion along a stream line - Bernoullie's equation and its application-venturimeter, orifice meter and pitot tube- Momentum equation-Navier Stokes equation . (09 hours)

UNIT – III

Reynolds experiment-laminar viscous flow through circular pipe- Hagen Poiseuille equation- viscosity measurement-falling sphere method, rotating cylinder method, Redwood viscometer. Flow losses in pipes –Major loss-Darcy Weisbach equation – Chezy's formula. Minor energy losses- sudden enlargement and contraction, bends and elbows-compound pipes-equivalent pipe. (09 hours)

UNIT – IV

Dimensional analysis- Fundamental and derived quantities-dimensional homogeneity-Methods of dimensional analysis- Rayleigh method-Buckingham Π theorem.
Model analysis-Similitude-dimensionless numbers and Model laws-Reynolds, Froude, Euler, Weber and Mach model laws. (09 hours)

UNIT – V

Laminar and turbulent boundary layers – boundary layer growth over a flat plate-boundary layer thickness, displacement, momentum and energy thickness-Blasius solution-drag force on a flat plate due to boundary layer- local coefficient of drag-average coefficient of drag-Separation of boundary layer and its control. (09 hours)

Text Books:

1. R. K. Bansal, A Textbook of Fluid Mechanics and Hydraulic Machines, 9th Edition, Laxmi Publications, 2010.
2. P. N. Modi, S. M. Seth, Hydraulics and fluid mechanics including hydraulic machines, 19th edition, Standard Publishers Distributors (2013)
3. D.S.Kumar, Fluid Mechanics and Fluid Power Engineering (SI Units), SK Kataria & Sons, 2010.

Reference Books:

1. Yunus A. CengelFluid Mechanics : Fundamentals and Applications, 3rd Edition, McGraw Hill Education (India) Pvt Ltd,2014
2. Fox, Fluid Mechanics: 8th Edition, Wiley India Pvt Ltd,New Delhi, 2013

Web References:

1. en.wikipedia.org/wiki/Fluid_mechanics
2. en.wikipedia.org/wiki/Fluid_dynamic
3. nptel.ac.in/courses/105101082/
4. www.engineeringtoolbox.com/fluid-mechanics-t_21.html

MET33 APPLIED THERMODYNAMICS (3 1 0 4)

OBJECTIVES

To familiarize the students with the fundamentals of thermodynamics so that a basis can be provided for the design of thermal machines

UNIT – I

Ideal and Real gases: Laws of perfect gases – Boyle's law – Charle's law – Gay Lussac law – Joule's law – Avogadro's law – state equation of gases – specific heat of gases. VanderWalls equation, Redlich Kwong equation, Dieterici equation, compressibility charts.

Gas mixtures: Mole fraction, mass fraction – calculation of mixture properties.
Pure substances: Phase change, 2D and 3D thermodynamic charts of pure substances – properties of steam – property tables – Mollier diagram. (09 hours)

UNIT – II

Energy and Entropy: I law of thermodynamics – energy balance of closed and open systems. Steady and unsteady flow systems. II Law of thermodynamics – Entropy generation principle, its application, entropy balance of closed and open systems.
(09 hours)

UNIT – III

Exergy: Introduction to exergy – reversible work – useful work – decrease of exergy in processes – dead state – availability – irreversibility – exergy balance of closed and open systems – second law efficiencies of thermal equipments. (09 hours)

UNIT – IV

General thermodynamic property relations: Maxwell equations – Tds equations – property relations of gases – Clausius-Clapeyron equation – Joule-Thomson coefficient – Gibbs phase rule – equilibrium condition.
(09 hours)

UNIT – V

Combustion: Stoichiometry – reactant and product quantities – Enthalpy of formation – Steady flow analysis of reacting mixtures – Adiabatic Flame temperature – Enthalpy of reaction and heating values – availability in chemical reactions.– combustion analysis (09 hours)

Text Books:

1. P.K. Nag, Engineering Thermodynamics, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2008.
2. Y. Cengel and M. Boles, Thermodynamics - An Engineering Approach, Tata McGraw Hill, 7th Edition, 2010.

Reference Books :

1. C.P.Arora, Thermodynamics, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2003.
2. Rathakrishnan E, Fundamentals of Engineering Thermodynamics, 2nd Edition, PHI Learning Pvt. Ltd., New Delhi, 2008.
3. www.nptel.ac.in

MET34 MANUFACTURING PROCESSES (4 0 0 4)

OBJECTIVES

This course aims to impart the knowledge about various manufacturing processes. It deals with metal casting, metal forming and metal joining processes. After this course, a student will have a good exposure about the manufacturing processes and various operations and machinery. This also gives the recent trends in these processes also.

UNIT - I

Introduction to manufacturing processes – classification – steps involved in casting process – different types of casting – pattern and core making – materials, types and allowances – moulding tools and equipment - properties of moulding sand - casting defects and remedies. (9 hours)

UNIT - II

Types of welding processes – weldability - gas welding – oxy acetylene welding - Introduction to arc welding – types and equipment – resistance welding – types and applications - welding defects– Introduction to welding standards – welding of dissimilar metals and non-metals. (9 hours)

UNIT - III

Classification of metal forming processes – Rolling, Forging, Extrusion, Drawing and other Sheet metal operations: terminology used, processes, machines and defects. (9 hours)

UNIT - IV

Surface Finishing Processes: Surface Finish and Surface Roughness Honing – Lapping – Superfinishing – Abrasive Belt Finishing – Mass Finishing Processes – Polishing – Buffing. Grinding : Types of grinding – Types of Grinding machines – Size and specification of Grinding machines - Work Holding Devices – Grinding Operations - Grinding Fluids – Grinding Speed, Feed and Depth of Cut. (9 hours)

UNIT - V

Plastics and polymers – structure of polymers – additives in plastics – thermoplastics and thermosetting plastics – manufacturing of plastic products – different moulding methods – forming or shaping methods – laminating methods – machining of plastics – joining plastics – industrial applications of plastics. (9 hours)

Note: Elementary treatment only for all the five units

Text Books:

1. B.S.Nagendra Parashar & R.K.Mittal – Elements of Manufacturing Processes, Prentice Hall India Pvt. Ltd., 2003.
2. J.P.Kaushish – Manufacturing Processes, Prentice Hall India Pvt. Ltd., 2008.

Reference Books:

1. E.Paul DeGarmo, J.T.Black and Ronald A.Kosher – Materials and Processes in Manufacturing, Prentice Hall India Pvt. Ltd., 2008.
2. Roy A.Lindberg - Processes and Materials of Manufacture, Prentice Hall India Pvt. Ltd., 2002.
3. S.K.Hajra Choudry - Workshop Technology, Vol. - I, & II, Media Promoters and Publishers Pvt. Ltd., 2009.
4. www. Myebookslibrary.com/workshoptechnology-by-hajrachoudry-vol.1-pdf-download.pdf.

MET35 ELECTRICAL AND ELECTRONICS ENGINEERING (3 1 0 4)

OBJECTIVES

- *To understand the construction and operation of Transformers.*
- *To understand the construction and operation of Induction machines.*
- *To understand the construction and operation of Alternators.*
- *To acquire knowledge about operational amplifiers and its applications.*
- *To acquire knowledge about 555 IC and its applications.*

UNIT – I: Transformers

EMF Equation – Equivalent circuit – Voltage regulation - OC and SC Test – Efficiency – condition for maximum efficiency – All day efficiency – Autotransformer – introduction to three phase Transformer. (9 hours)

UNIT – II: AC Machines

Theory and operation of 3 phase Induction motor - constructional details – starting methods – speed control methods – principle of operation of single – phase Induction motor – stepper motor – AC series motor – Applications. (9 hours)

UNIT – III: Alternators

Alternators - construction - Operating principle - alternators on No load – Alternators on Load - Phasor diagram - Losses – Efficiency-voltage regulation by EMF method – Parallel operation of alternators. (9 hours)

UNIT – IV: Electronics

Op. amp. – Characteristics – Inverting amplifier - Non-inverting amplifier – differentiation integration I/V converter - V/I converter - Instrumentation amplifier – adder – substractor – First order low pass filter and High pass filter using op. Amp. (9 hours)

UNIT – V

Advantages of ICs - pin configurations of 555 IC - Design of astable and mono-stable multivibrator using 555 IC - design of counters using FF-UP/DOWN counters– -Ring counters - Multiplexes –De multiplexes. (9 hours)

Text Books:

1. I.J.Nagrath & D.P.Kothari, Electric Machines, IV Edition, Tata Mc-Graw-Hill Education., New Delhi, 2010
2. Ramakant A Gayakward, Operational Amplifiers and Linear Integrated circuits, 4th Edition,PHI Learning, Delhi, 2009.

Reference Books:

1. 1. Albert Malvino and David Bates, “Electronic Principles”, 7th Edition, Tata Mc-Graw Hill, New Delhi, 2006.
2. B.L.Theraja & A.K.Theraja, A Textbook of Electrical Technology: AC and DC Machines, Voloume - II, 23rd Edition, S. Chand & Company, New Delhi, 2012.

MEP31 MATERIAL TESTING AND METALLURGY LABORATORY (0 0 3 2)

OBJECTIVES

- *To train the students in performing basic metal characterization studies and in measuring physical properties of materials relevant to mechanical engineering using various machines and equipments.*

LIST OF EXPERIMENTS:

MATERIALS TESTING LABORATORY

1. Tension test
2. Compression test
3. Impact test - Izod test
4. Brinell Hardness test
5. Rockwell Hardness test
6. Ductility test : Sheet metals (Al, GI and MS)
7. Impact test – Charpy test

METALLURGY LABORATORY

1. Study of Metallurgical microscope
2. Preparation of a Specimen for microscopic examination
3. Identification of the Metal 1
4. Identification of the Metal 2
5. Identification of the Metal 3
6. Study of Heat Treatment Processes on metals
7. Study of various Quenching mediums
8. Hardening of Steel
9. Normalizing of Steel
10. Annealing of Steel
11. Jominy end quenching test

MEP32 MANUFACTURING PROCESSES LABORATORY – I (0 0 3 2)

OBJECTIVES

- *To train the students in performing basic metal cutting operations using lathe, shaping machine and milling machine.*

LIST OF EXPERIMENTS:

LATHE:

1. Study of Lathe
2. Plain turning and facing
3. Step turning, grooving, chamfering and knurling
4. Taper turning by swiveling the compound rest
5. Taper turning by taper turning attachment
6. V – thread cutting

SHAPING MACHINE:

7. Study of Shaping Machine
8. Cube shaping
9. Shaping and grooving

MILLING MACHINE:

10. Study of Milling Machine
11. Cube milling
12. Step milling

MEP33 ELECTRICAL AND ELECTRONICS LABORATORY (0 0 3 2)

OBJECTIVES

- *An ability to design and conduct experiments on Transformers, AC and DC electrical machines for their performance analysis. Inverting / Non-Inverting Amplifier and Adder / Substractor using Op.Amps, Astable Multivitbrator and Counter to analyze & interpret results.*

LIST OF EXPERIMENTS:

1. OC and SC Test on Single Phase Transformer
2. Load Test on Single Phase Transformer
3. Load Test on 3 Phase Transformer
4. Load Test on Single Phase Induction Motor
5. Two Wattmeter Method of Power Measurement
6. Pre-determination of voltage regulation of 3 phase Alternator by EMF method
7. Inverting and Non-Inverting Amplifier Using 741 IC
8. Astable Multivitbrator Using 555 IC
9. Counter Using 7490 IC
10. Adder / Substractor Using 741 IC

MAT41 MATHEMATICS – IV (3 1 0 4)

AIM: This course is mainly focused on understanding the concepts and techniques for solving analytically Partial Differential Equations and Boundary Value Problems and concepts of Theory of Sampling.

OBJECTIVES

- *Importance of Partial differential equations*
- *Problem solving techniques of PDE*
- *To make the students knowledgeable in the areas of Boundary Value Problems like vibrating string (wave equation), Heat equation in one and two dimensions.*
- *To acquaint the students with the concepts of Theory of sampling.*

PARTIAL DIFFERENTIAL EQUATIONS

UNIT – I

Formation of PDE by elimination of arbitrary constants and arbitrary functions – General singular. Particular and complete integrals – Lagrange's linear first order equation – Higher order differential equations with constant coefficients. (09 hours)

UNIT – II

Solution of partial differential equation by the method of separation of variables – Boundary value problems – Fourier series solutions – Transverse vibration of an elastic string. (09 hours)

UNIT – III

Fourier series solution for one dimensional heat flow equation – Fourier series solutions for two dimensional heat flow equations under steady state conditions (Cartesian and polar forms). (09 hours)

APPLIED STATISTICS

UNIT – IV

Curve fitting by the method of least squares – fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations. (09 hours)

UNIT – V

Small samples: Test for single mean, difference of means and correlation coefficients – test for ratio of variances – Chi–Square test for goodness of fit and independence of attributes. (09 hours)

Text books:

1. M.K.Venkataraman, Engineering Mathematics, Vol. II & III, National Publishing Co., Madras, 2007.
2. S.C. Gupta & V.K. Kapoor, Fundamentals of Mathematical Statistics, S. Chand & Sons, New-Delhi, 2008.

Reference books:

1. N.P. Bali & Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, New- Delhi, 2008.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John- Wiley sons, New-York, 2005.
3. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New-Delhi,
   2008.

MET41 ENGINEERING METALLURGY (4 0 0 4)

OBJECTIVES

- *To acquaint students with the basic concepts and properties of Material Science.*
- *To impart a fundamental knowledge of Ferrous & Non Ferrous Metal Processing*
- *To help them to home in on the right material when they design some components.*
- *To familiarize students with the various kinds of testing done on the metals.*
- *To develop futuristic insight into Metals*

UNIT – I

Crystal structures - Solid Solutions – Types - Metallography – Metallurgical microscopes – specimen preparation- Cooling curves – Allotropy concept. (09 hours)

UNIT – II

Construction and interpretation of binary phase diagrams – Types – Eutectic, Eutectoid, Petitectic and Peritectoid systems – Iron Carbon equilibrium diagrams – classification of steels and alloy steels – types, manufacture, properties and applications of cast irons. (09 hours)

UNIT – III

Heat treatment of steel: Critical temperature on heating and cooling, effects of residual stresses – Annealing, normalizing, hardening, Hardenability tests, tempering – construction and interpretation of TTT diagram – Martensitic transformation – Sub zero treatment - Surface hardening processes. (09 hours)

UNIT – IV

Non ferrous metals and alloys: Copper, Aluminium, Nickel, Zinc and Lead based alloys – concept and applications of metal matrix composites. Mechanical properties of materials – Testing of materials: Tensile, compression, torsion, hardness (micro & macro) and impact testing. (09 hours)

UNIT – V

Plastic deformation, Slip and twinning – Hot, cold and warm working – recovery and recrystallization concepts. Introduction to fracture mechanics – Types - ductile to brittle transition – Creep and Fatigue failures – Testing. (09 hours)

Text Books:

1. Raghavan V, Physical Metallurgy – Principles and Practice, Prentice Hall India Pvt. Ltd., New Delhi, 2006
2. S.H.Avner, Introduction to Physical Metallurgy, Tata-McGraw Hill Publishing Co., New Delhi, 2000.
3. G.E.Dieter, Mechanical Metallurgy, McGraw Hill Publishing Co., New York, 1988.

Reference Books:

1. Donald R. Askeland, The Science and Engineering of Materials, Chapman and Hall, 1990.
2. Raghavan V, Materials Science and Engineering, Prentice Hall India Pvt. Ltd.,New Delhi, 2007
3. Budinski and Budinski, Engineering Materials – Properties and Selection, Prentice Hall India Pvt. Ltd., 2005

MET42 FLUID MACHINERY (3 1 0 4)

OBJECTIVES

- *To make the students understand the principle of working of turbo machines and positive displacement pumps with examples.*
- *To teach them the application of impulse momentum equation and velocity triangles*
- *To teach the different types hydraulic turbines based on their working heat and method of energy conversion.*
- *To teach the calculation of performance parameters of turbines and pumps*
- *To teach them the working of reciprocating pumps and its performance characteristics*
- *To make them to understand the concept of specific speed*
- *To teach the students the principle of working and application of compressors, blowers and fans*
- *To impart a knowledge of different types of special purpose pumps and their application*

UNIT – I

Types of fluid machines- impulse momentum principle– impact of fluid jet on stationary plates, moving plates and vanes- velocity triangles-estimation of force, power and efficiency (09 hours)

UNIT – II

Hydraulics Turbines: classification – impulse turbine – Pelton Wheel – reaction turbines –Francis and Kaplan Turbines – draft tube theory – velocity triangle – estimation of force, power and efficiency – unit quantities and specific speed performance characteristics-cavitation-governing of turbine. (09 hours)

UNIT – III

Hydraulic Pumps- classification - centrifugal pump – velocity triangle – estimation of power required and efficiency – specific speed- net positive suction head-cavitation-general characteristics- multistage pumps.
Reciprocating pump-types-working- estimation of power required- percentage slip and efficiency- ideal and actual indicator diagram-air vessels. (09 hours)

UNIT – IV

Air machines: classification–compressor– reciprocating compressor- power required-isothermal and volumetric efficiency- single stage compressor with and without clearance –multistage compressors- inter cooling.
Introduction to rotary compressors- centrifugal and axial flow compressors-root blower and vane type blower-centrifugal fans and axial flow fans. (09 hours)

UNIT – V

Special purpose fluid pumps and machines**:** gear pump – vane pump – screw pump – vacuum pump – self priming pump – diaphragm pump – turbine pump – jet pump – rotary pump – pneumatic pump – submersible pump – hydraulic press, jack, accumulator, intensifier, crane and lift - hydraulic coupling – torque converter - theory and applications. (09 hours)

Text Books:

1. R. K. Bansal, 'A Textbook of Fluid Mechanics and Hydraulic Machines' 9th Edition, Laxmi publications 2010.
2. P. N. Modi, S. M. Seth, 'Hydraulics and fluid mechanics including hydraulic machines', 19th edition, Standard Publishers Distributors, 2013
3. D.S.Kumar, Fluid Mechanics and Fluid Power Engineering, SK Kataria & Sons, 2010.
4. R.K.Rajput, Thermal Engineering, Laxmi Publications, 2010.

Reference Books:

1. V. Kadambi and Manohar Prasad, Turbomachinery, Vol. III, 2nd Edition, New Age International Publishers, 2011.
2. S. M. Yahya, Turbines Compressors and Fans, 4th Edition, McGraw Hill Education (India) Pvt Ltd, 2010

Web References

1. www. en.wikipedia.org/wiki/**Hydraulic**_machinery
2. www.learnengineering.org/2014/01/
3. www.engineeringtoolbox.com

MET43 KINEMATICS OF MACHINERY (3 1 0 4)

OBJECTIVES

- *Teach students about basics of kinematic approach to visualize simple mechanisms and its applications.*
- *Illustrate students about Kinematic Analysis (Instantaneous center method and relative velocity method) of simple mechanisms*
- *Teach students about graphical and analytical two point and three point Synthesis of Mechanisms.*
- *Teach students about different types of specified contour and derived contour cams and its kinematic analyses.*
- *Explain about kinematic advantages, problems and how these problems are avoided for involute profiled gear. Also explain about epicyclic gear train and its speed calculation.*

UNIT – I

Introduction: Mechanisms and machines; Elements of kinematic chain, mobility and range of movements, Definition & Concept - inversion of single and double slider chain and four bar chain and its applications
Mechanism with lower pairs -Pantograph, Straight line mechanism- exact and approximate Motion, Engine indicator, Motor car Steering gears, Hooke joint, Toggle mechanism. (09 hours)

UNIT- II

Kinematic Analysis of Mechanisms: Analysis of displacement, velocity & acceleration diagrams of simple planar mechanisms by graphical (Instantaneous center method and relative velocity method), analytical and computer aided methods (for four-bar and slider crank mechanism only), Coriolis component of acceleration. (09 hours)

UNIT – III

Kinematic Synthesis of Mechanisms: Kinematic synthesis, graphical method using relative pole method, Inversion method and overlay 3 point synthesis problems - Motion, path & function generation, Chebyshev's spacing of accuracy points Freudenstein Method of 3 point synthesis of four link mechanism and slider crank mechanism. Coupler curves. (09 hours)

UNIT – IV

Cams: Types of cams and followers, displacement velocity and acceleration curves for uniform velocity, uniform acceleration and retardation, SHM, cycloidal motion, layout of profile of plate cams of the above types with reciprocating, oscillating, knife-edge, roller and flat faced followers. Cylindrical and face cams, polynomial cams, cams with special contours. Tangent cams with reciprocating roller follower, circular arc cam with flat faced follower. (09 hours)

Unit – V

Gears and Gear Trains: Classification and terminology used, Fundamental law of gearing – friction wheel, teeth for positive action and condition for constant velocity ratio. Conjugate profiles cycloidal and involute teeth profiles. Involute construction, properties and computation of path of contact and contact ratio. Interference and undercutting- Minimum number of teeth to avoid Interference, methods to avoid Interference.
Introduction, classification, examples, gear ratio in simple and compound gear trains, Automobile gear box, Planetary gear trains-methods of evaluating gear ratio - Differential gear box. (09 hours)

Content beyond syllabus:

1. Using kinematics Kits students will be allowed to develop different mechanisms and verify its working.
2. Synthesis of mechanisms based on coupler curve and rigid body guidance methods.
3. Motor car Steering gears and differential gears applications in an automobile.

Text books:

1. J.J. Uicker, Jr., G.R. Pennock, and J.E. Shigley - Theory of Machines and Mechanisms, Oxford University Press, 2011.
2. S S.Rattan - Theory of Machines, Tata McGraw Hill, 2009.

Reference books:

1. J.S.Rao and R.V.Dukkipati - Mechanism and Machine Theory, New Age International, 2012.
2. Thomas Bevan - Theory of Machines, CBS Publishers & Distributors, 2005.
3. P.L.Ballaney - Mechanics of Machines, Khanna Publishers, 2012.

Web Reference:

1. http://nptel.iitm.ac.in/video.php?subjectId=112104121
2. http://www.learnerstv.com/Free-engineering-Video-lectures-ltv070-Page1.htm

MET44 MACHINE DRAWING (2 0 3 4)

OBJECTIVES

To make the students understand and interpret drawings of machine components so as to prepare assembly drawings manually.

UNIT –I

Conventions for sectioning and dimensioning, screw threads, rivets, bolts, nuts, pins, keys, cotter, gear, springs and welds. Component drawing assigning fits and tolerance machine symbol, surface finish geometrical tolerance.

(**L – 6 Hours + P – 9 Hours)**

UNIT – II

Preparation of drawings of parts and assembly of:-

Joints

Riveted joints - butt joints and lap joints
Pin joints - knuckle joints
Cotter joints -sleeve, socket and spigot joints

Couplings:-

Split muff couplings, flexible type flange coupling, universal coupling

Bearing:-

Pedestal bearing, swivel bearing, Plumber block

Screw jack
Connecting rods
Tail stock
Four way tool post
Stop valve – steam
Centrifugal pump (**L – 24 Hours + P – 36 Hours)**

Text books:

1. Bhatt, N.D “Machine Drawing”, Charotar Publishing House.2008
2. Gopalakrishnan,K.R, “Machine Drawing”, SUBHAS Publications,VIII edition,2004

Reference books:

1. Gupta, R.B, “Machine Drawing” ,Satya Prakasham,1998
2. Sidheswar, “Machine Drawing” Tata McGraw Hill edition, 2006
3. Sadhu Singh and P.L. Sah, Fundamentals of Machine Drawing, PHI 2005

MET45 MACHINING PROCESSES (3 1 0 4)

OBJECTIVES

To understand the concept and basic mechanics of metal cutting, working of standard machine tools such as lathe, shaping and allied machines, milling, drilling and allied machines, grinding and allied machines and cutting tools.

UNIT – I: TURNING OPERATIONS

Lathe – Types, Designation, Work holding devices – Cutting Speed, Feed and Depth of Cut, MRR - Operations, Machining Time. (9 hours)

UNIT – II: DRILLING AND ALLIED OPERATIONS

Drilling Machines - Types, Operations, Machining Time - Boring, Reaming and Tapping (Definition of operations only) (9 hours)

UNIT – III: BASIC MACHINING OPERATIONS

Shaper, Types, Shaping Operations, Planner, Types, Planning Operation, Slotting Machine Operations. (9 hours)

UNIT – IV: ADVANCED MACHINING OPERATIONS

Milling Machine, Types, Milling Process, Milling Operations, MRR, Machining Time. Introduction to unconventional machining – EDM, ECM, ECG, AJM and USM. (9 hours)

UNIT – V: CUTTING TOOLS/FLUIDS

Tool Materials, Nomenclature and Geometry of Cutting Tools, Tool wear Mechanisms, Tool Life – Tool Life Criteria. Cutting Fluids - Categories, Desirable Properties, Selection of Cutting Fluids. (9 hours)

Text/Reference Books:

1. B.S.Nagendra Parashar, R.K.Mittal. “Elements of Manufacturing Processes” - Prentice - Hall of India Pvt. Ltd; New Delhi – 1,2012.
2. R.K.Singal, Mridul Singal, Rishi Singal. “Fundamentals of Machining and Machine Tools” - I.K.International Publishing Home Pvt. Ltd; New Delhi,2008.
3. Roy.A.Lindberg, “Process and Materials of Manufacture”, Prentice Hall India Pvt. Ltd, 2002.
4. www.egr.msu.edu/pkwon/me478/operations.pdf

MEP41 FLUID MECHANICS AND MACHINERY LABORATORY (0 0 3 2)

OBJECTIVES

- *To identify safe operating practices and requirements for laboratory experiments.*
- *To design and conduct an experiment as well as to analyze and interpret data.*
- *To cover the elements of fluid mechanics in fluid flow systems.*
- *To cover a range of experimental techniques aiming to provide students with a general knowledge and understanding of the subject fluid mechanics and machinery, including recommendations for further studies.*

UNIT I: FLOW VISUALIZATION AND MEASUREMENT

Flow visualization -Heleshaw, Reynolds experiment, verification of Bernoulli's theorem, solid body rotation, calibration of flow measuring instruments – venturimeter, orificemeter and rotometer.

UNIT II: PUMPS

Determination of performance characteristics of pumps – centrifugal pumps, submersible pumps, turbine pumps and positive displacement pumps – reciprocating and gear pumps.

UNIT III: TURBINES

Determination of performance characteristics of turbines – reaction turbines and impulse turbines.

List of experiments:

1. Determination of the coefficient of discharge of given Orifice meter.
2. Determination of the coefficient of discharge of given Venturi meter.
3. Calculation of the rate of flow using Rota meter.
4. Visualizing the flow structures through various models.
5. Proving Bernoulli's theorem.
6. Conducting experiments and drawing the characteristics curves of centrifugal pump.
7. Conducting experiments and drawing the characteristics curves of submersible pump.
8. Conducting experiments and drawing the characteristics curves of jet pump.
9. Conducting experiments and drawing the characteristics curves of pump in series and parallel.
10. Conducting experiments and drawing the characteristics curves of reciprocating pump.
11. Conducting experiments and drawing the characteristics curves of Gear pump.
12. Conducting experiments and drawing the characteristics curves of Pelton wheel.
13. Conducting experiments and drawing the characteristics curves of Francis turbine.
14. Conducting experiments and drawing the characteristics curves of Kaplan turbine.
15. Conducting experiments and drawing the characteristics curves of hydraulic ram.

Text Books:

1. CWR, Hydraulics Laboratory Manual,2004
2. N. Kumarasamy, Fluid Mechanics and Machinery laboratory manual, Charotar Publishing House Pvt. Ltd. 2008.

Reference Books:

1. S K Agrawal , Fluid Mechanics and Machinery, Tata McGraw-Hill Education, 2001
2. Subramanya, Fluid Mechanics and Hydraulic Machines, Tata McGraw-Hill Education, 2011.
3. S C Gupta, Fluid Mechanics and Hydraulic Machines, Pearson Education India, 2006.

Web Reference:

1. http://en.wikipedia.org
2. **http://www.engineeringtoolbox.com**

MEP42 MANUFACTURING PROCESSES LABORATORY – II (0 0 3 2)

OBJECTIVES

To train the students in performing basic metal cutting operations using lathe, shaping machine, milling machine and grinding machine.

LIST OF EXPERIMENTS:

LATHE:

1. Drilling and boring
2. Turning between centres
3. Square thread cutting
4. Multi start thread cutting
5. Eccentric turning

SHAPING MACHINE:

6. V – shaping

MILLING MACHINE:

7. Spline milling
8. Key way milling

GRINDING MACHINE:

9. Study of grinding machine
10. Cylindrical grinding

MEP43 COMPUTER AIDED MACHINE DRAWING LABORATORY (0 0 3 2)

OBJECTIVES

- *To expose the students to CAD /CAE software in the design and drawing of machine components*
- *Create 2-D Sketches*
- *To draw various permanent and temporary joints*
- *To be able to understand and find mistakes in the diagrams drawn by draughtsman*
- *Create assembly models of simple machine (minimum 5 components)*

I	Draw the orthographic views for the given simple 3D blocks using AutoCAD screen icons--Minimum two exercises
II	Draw the orthographic views for the given simple 3D blocks using AutoCAD script file - Minimum two exercises
III	Draw the isometric view for the objects given in orthographic views. Minimum two exercises
IV	Preparation of Drawings for Parts and Assembly of the following by using Drafting software.
V	Gear coupling, spring loaded safety valve, lever safety valve ,blow-off cock, cast iron flange joint, hydraulic joint, feed check valve, foot step bearing, ball valve, stuffing box- minimum 5 exercises
VI	Preparation of Production Drawings with tolerances limits and fits using Drafting software.--Minimum one exercise

Important Note

Submission of all above assignments may be made in electronic format (preferably in single CD/DVD for all batches/students) and may be reviewed by external examiner at the time of Practical Examination.

References:

1. Ajeet Singh, Machine Drawing Includes AutoCAD, Tata McGraw-Hill Publishing Company, New Delhi, 5th Reprint, 2011.
2. Bhatt.N.D. and Panchal.V.M. “Machine Drawing”, Charotar Publishing House, 38th Edition, 2003.
3. Sham Tikoo, “AutoCAD 2002 with Applications”, Tata McGraw-Hill Publishing Company, New Delhi, 2002.
4. Goutam Pohit, Goutam Ghosh, Machine drawing with AutoCAD, Pearson Education, 1st Ed., 2005.
5. K.L.Narayana, P.Kannaiah, K.Venkata Reddy, Machine drawing, New Age International, 3rd Ed., 2006.

MEP44 PHYSICAL EDUCATION

Physical Education is compulsory for all the Undergraduate students

1. The activities will include games and sports / extension lectures.
2. Two Hrs. / Week will be allocated for physical education in the third and fourth semesters. Minimum of 75% attendance is mandatory.
3. These activities will be monitored by the Director of Physical Education.
4. Pass /Fail will be determined on the basis of participation, attendance, and performance. If a candidate Fails, he/she has to repeat the course in the subsequent years
5. Pass in this course is mandatory for the award of degree.

MET51 DYNAMICS OF MACHINERY (3 1 0 4)

OBJECTIVES

- *Teach students about calculation of inertia force and inertia torque slider crank mechanism and functional utilization of flywheel.*
- *Illustrate students about effect of free and forced vibration and finding natural frequency for simple longitudinal, transverse and torsional vibrating system*
- *Teach different types of governors and characteristics. And also study about gyroscopic effect on ship, plane, two wheeler and four wheeler.*
- *Teach about rotary mass and reciprocating mass balancing techniques*

UNIT – I

D'Alembert's Principle-Inertia forces of reciprocating parts, Dynamic analysis of four link and slider-crank mechanisms, Engine force Analysis Turning moment on crankshaft, Dynamically Equivalent system, Inertia forces in a reciprocating engine , Turning Moment diagrams, Fluctuations of Energy and speed, Flywheel. (09 hours)

UNIT – II

Basic concepts of S.H.M, Causes and effects of vibration and degrees of freedom. Natural frequency of free oscillations – equivalent system – energy method – simple problems, Damped free vibration of single degree of freedom system, forced vibration. Basic of vibration isolation, Transmissibility and vibration absorbers. (09 hours)

UNIT – III

Transverse vibrations of beams-Natural frequency by energy method, Dunkerly's method, Whirling of shafts- calculation of whirling speed for loaded shafts. Torsional vibrations-causes of Torsional vibration. Torsional Vibration of two and three rotor systems. Equivalent shaft system, Geared system. (09 hours)

UNIT – IV

Governors - Types - Centrifugal governors - Gravity controlled and spring controlled centrifugal governors –Characteristics - Effect of friction - Controlling Force - other Governor mechanisms. Gyroscopes - Gyroscopic forces and Torques - Gyroscopic stabilization - Gyroscopic effects in Automobiles, ships and airplanes. (09 hours)

UNIT – V

Static and dynamic balancing of rotating masses in different planes - partial balancing of reciprocating masses of inline, V, W and radial engines. (09 hours)

Content beyond syllabus:

1. Finding equation of motion for simple vibrating system.
2. Practical methods adopted for vibration isolation.
3. Governing of speed of I.C engine in recent automobiles.

Text books:

1. J.J. Uicker, Jr., G.R. Pennock, and J.E. Shigley - Theory of Machines and Mechanisms, Oxford University Press, 2011.
2. S S.Rattan - Theory of Machines, Tata McGraw Hill, 2009.

Reference books:

1. J.S.Rao and R.V.Dukkipati - Mechanism and Machine Theory, New Age International, 2012.
2. Thomas Bevan - Theory of Machines, CBS Publishers & Distributors, 2005.
3. P.L.Ballaney - Mechanics of Machines, Khanna Publishers, 2012.
4. Singiresu S. Rao. - Mechanical Vibrations, Pearson Education, 2011.

Web Reference:

1. http://nptel.iitm.ac.in/video.php?subjectId=112104114
2. http://www.learnerstv.com/Free-engineering-Video-lectures-ltv069-Page1.htm

MET52 DESIGN OF MACHINE ELEMENTS (3 1 0 4)

OBJECTIVES

- *To teach students how to apply the concepts of stress analysis, theories of failure and material science to analyze, design and/or select commonly used machine components.*
- *To illustrate to students the variety of mechanical components available and emphasize the need to continue learning.*
- *To teach students how to apply mechanical engineering design theory to identify and quantify machine elements in the design of commonly used mechanical systems.*
- *To teach students how to apply computer based techniques in the analysis, design and/or selection of machine components.*

UNIT - I

Fundamentals of machine design - Design philosophy- Engineering Materials- Brief overview of design and Manufacturing – Principal Stresses -Failure Theories - Design of Welded Joints -Types – Strength – Eccentric Loaded welded joints – Welded joints subjected to fluctuating load. (09 hours)

UNIT - II

Strength and Stability Criteria, Design of Power Screws. Threaded Joints – Bolted Joints under fluctuating load, Combined Stresses, and eccentric loading. (09 hours)

UNIT - III

Design of Couplings – Design of Rigid and flange Couplings – Types of Clutches and Design of Clutches. Types of Brakes – Design of Brakes. (09 hours)

UNIT - IV

Introduction to Design of Helical Springs-Design of Helical Springs for Variable Load-Design of Leaf Springs- Design of Pipe Joints – Cotter and Knuckle joints.
(09 hours)

UNIT - V

Design of Shafts under static load: members subjected to Eccentric loading – stresses in curved beams. Design of Shafts under Fluctuating Load: Design for Finite and Infinite life – Soderberg and Goodman equations – combined stresses.
(09 hours)

Content Beyond Syllabus:

1. Design for finite and Infinite life

Text books:

1. V.B.Bhandari -Design of Machine Elements, Tata McGraw Hill publishing Co., 2010.
2. Sharma and Purohit, ., Design of Machine Elements, PHI, 2009.
3. Ganesh Babu, K. and Srithar, K., Design of Machine Elements, McGraw Hill Education (India) Pvt. Ltd., Noida, 2009

Reference books:

1. J. Shigley, Mechanical Engineering Design, McGraw Hill International Edition, 2011.
2. Abdul Mubech, Machine Design, III Edition, Khanna Publishers, 1998.
3. Sadhu Singh, Machine Design, III Edition, Khanna Publishers, 2001.

E-learning sources:

1. www.nptel.iitm.ac.in
2. www.shellbuckling.com

MET53 METROLOGY AND QUALITY CONTROL (4 0 0 4)

OBJECTIVES

- *To emphasize the importance of metrology in Engineering Design, Manufacturing and Quality control.*
- *To explain about International standards adopted in measurements to achieve interchangeability.*
- *To explain the Definitions of Fit and Tolerance (Taylors Principle) for learning standards adopted in hole making and shaft making systems.*
- *To expose students to various basic and advanced Measuring instruments and their appropriate usage.*
- *To brief the principles of SQC and how it could be used for continuous improvement to develop a defect free manufacturing system.*

UNIT - I

Introduction to Measurements: Definition and Objectives of metrology, Standards of Measurement**:** Standards of length – International prototype meter, Imperial Standard yard, Wave length standard, subdivision of standards, line and end standard, comparison, transfer from line standard to end standard, calibration of end bars (Numerical), slip gauges, wringing phenomena, Indian Standards (M-112), Numerical problems on building of slip gauges.

Introduction to interchangeable Manufacturing, Principles of Gauge design – Types of Gauges, Taylor's Principle of Gauge design, Limits, Fit and Tolerances (09 hours)

UNIT - II

Comparators - Types and working principle of Mechanical, Pneumatic, Electronic, Electrical, Optical Comparators and their Applications.

Interferometer - Principles, Sources of Light, Optical Flats, Fringe Patterns, N.P.L Flatness Interferometer. Tool Maker's Microscope, Profile Projector.

Surface Finish Measurement: Terminology as per Indian Standards, Surface Finish Measuring Instruments – Tomlinson Surface meter, The Taylor-Hobson Talysurf. Analysis of Surface Traces – R.M.S & C.L.A Value. (09Hours)

UNIT - III

Angular measurements - Bevel Protractor, Sine Principle and use of Sine bars, use of angle gauges, (numerical on building of angles) Clinometers, Autocollimator-Principle and Applications.

Metrology of Screw Thread – Screw thread Terminology, Thread Gauges, Measurement of Thread Elements – Floating carriage Micrometer.

Gear Metrology: Gear Terminology, use of gear tooth Vernier caliper and gear tooth micrometer, Parkinson Gear testing machine.

Advances in Metrology: Coordinate Measuring Machine, Universal Measuring machine, Application of Laser in measurements and Automatic Inspection Systems.
(09 Hours)

UNIT – IV

Statistical Quality Control – Basic Statistics – Mean, Mode, Standard deviation, Frequency Disribution, Control charts for Variables, Attributes and Process capability.

Acceptance sampling: Sampling Inspection, Operating Characteristic (OC) Curve, Consumer's Risk, Producer's risk, AQL, LTPD, AOQL.
Types of Sampling Plan: Single, Double, Multiple and Sequential Sampling Plan.
(09 Hours)

Unit – V

Six Sigma: Types of defects, DMAC, Six Sigma program, Zero Defect.
Quality Standards – ISO 9000:2001, TS 16949 (Standard FMECA (Failure Mode Effect Criticality Analysis), FTA analysis (Fault Tree Analysis). (09 Hours)

Text books

1. R. K. Jain
   Engineering metrology Khanna Publisher, Delhi.
2. Gupta. I.C., "Engineering Metrology", Dhanpatrai Publications, 2005.
3. Gupta.R.C, "Statistical Quality Control", Khanna Publishers, New Delhi, 1994
4. Bewoor and Vinay Kulkarni, Metrology & Measurement, Tata Mc Graw Hill Publishing Company Pvt Ltd, New Delhi,2009.
5. Douglas C. Montgomery, Introduction to Statistical Quality Control, John Wiley and Sons Inc, 2008.

References

1. Charles Reginald Shotbolt, "Metrology for Engineers", 5th edition, Cengage Learning
   EMEA,1990.
2. Connie Dotson, Roger Harlow and Richard L. Thompson, "Fundamentals of Dimensional Metrology, Thomson Delmar Learning",4th edition, 2005.
3. M. Mahajan Statistical Quality Control Dhanpat Rai and Sons
4. Metrology for engineers- Frederick Wise Galyer, Shotbolt, 1990, ELBS

Web reference

1. www.nikonmetrology.com
2. www.mitutoyo.com
3. www.mahr.com
4. www.prismsindia.net
5. www.octagon.co.in

MET54 HEAT AND MASS TRANSFER (3 1 0 4)

OBJECTIVES

- *To convey the basics of the heat transfer principles.*
- *To establish the relationship of these principles to thermal system behaviour.*
- *To develop methodologies for predicting the system behaviour.*
- *To explain the role of exact solutions in the heat and boundary layer equations, numerical solution methods, heat transfer with phase change and design of heat exchangers.*
- *To develop an intuitive understanding of underlying physical mechanism and a mastery of solving practical problems in real world.*

UNIT - I

Heat Transfer by Conduction: Concept of heat conduction – Law of heat conduction – heat conduction equations; solution for steady state conduction; conduction with heat sources; extended surfaces – transient heat conduction, solution using Heisler's charts – measurement of thermal conductivity – effects of temperature on thermal conductivity – electrical analogy. (09 hours)

UNIT - II

Heat Transfer by Convection and with Phase Change: Convection – forced convection, external flow, laminar and turbulent flow over flat plate, cylinder and sphere – internal flow, laminar and turbulent flow through circular tubes – free convection, laminar flow over plates and tubes.
Condensation – concept of condensation – types - Nusselt's theory – heat transfer during condensation.
Boiling – pool boiling; regimes – nucleate boiling, film boiling, critical heat flux – flow boiling, pattern, heat flux. (09 hours)

UNIT - III

Heat Transfer by Radiation: Nature of thermal radiation-concept of black body, Stefan-Boltzman law, Kirchoff's law, intensity of radiation -radiative heat exchange between surfaces – shape factors – concept of grey body radiation between surfaces separated by non-absorbing medium-electrical analogy. (09 hours)

UNIT - IV

Double pipe heat exchangers, parallel and counter flows – Log Mean Temperature Difference (LMTD) – multi pass heat exchangers, analysis using correction factors – heat exchanger effectiveness – effectiveness expressed in terms of NTU for different configurations – effectiveness Vs NTU charts. (09 hours)

UNIT - V

Similarity between phenomena of heat transfer and mass transfer – diffusion mass transfer, Fick's Law of diffusion, species conservation equation-initial and boundary conditions, steady state molecular diffusion-diffusive mass transfer and convective mass transfer– momentum, heat and mass transfer analogies, convective mass transfer correlations, evaporation of water into air. (09 hours)

Content beyond syllabus:

1. Review of Differential equations, Calculus and basic of numerical methods used to solve heat transfer problems
2. Review of heat transfer through walls and roof of a building due to solar heat gain.
3. Introduction to commercial software to solve heat transfer problems.

Text books:

1. F.P.Incropera and D.P.Dewitt, Fundamentals of Heat and Mass Transfer, IV Edition, John Wiley &Sons, 2000.
2. J.P.Holman, Heat Transfer, X Edition, McGraw Hill Book Company, NY, 2009.

Reference books:

1. A.Bejan, Heat Transfer, John Wiley & Sons, 1993,
2. M.N.Ozisik, Heat Transfer: A Basic Approach, McGraw Hill Book Company, New York, 1985.
3. R.C.Sachdeva, Fundamentals of Engineering Heat and Mass Transfer, Wiley Eastern Ltd., 1997.

Web Reference:

1. http://nptel.iitm.ac.in/courses/Webcourse-c**on**tents/

MET55 MECHANICAL MEASUREMENTS (3 1 0 4)

OBJECTIVES

To provide knowledge on the instruments and techniques available for the measurement of different process variables relevant to Mechanical Engineering

UNIT - I

Basic detector transducer elements, signal conditioning systems, terminating devices and methods, terminologies of measurements, types of errors and their properties, measurement standards, Calibration principle. (09 hours)

UNIT - II

Strain measurement: Strain gauges, types, Wheatstone circuit, temperature compensation, gauge rosettes, calibration.
Force measurement: Scales and balances, elastic force meter, strain gauges, load cells, hydraulic and pneumatic load cells.
Torque measurement: Dynamometers, types. (09 hours)

UNIT - III

Pressure measurement: Gravitational, Bourdon, elastic transducers, strain gauges, pressure cells, measurement of very high and very low pressures, dynamic characteristics of pressure measuring devices, calibration.
Temperature measurement: Bimetallic, pressure and resistance thermometers, thermocouples, pyrometers and thermistors, calibration.
Flow measurement: Orificemeters, Venturimeters, Pitot tubes, rotameters. (09 hours)

UNIT - IV

Displacement Measurement: LVDT - Hall effect devices.
Motion measurement: Speed, stroboscopes. Vibration, characteristics, sensing devices. Accelerometer, types. Signal conditioner, voltage and charge amplifiers. Vibration exciters. FFT: Fast Fourier Transform analyser, concepts and techniques. (09 hours)

UNIT - V

Digital techniques in mechanical measurements: digital circuitry, A/D and D/A conversion, PC based data acquisition and processing, buses.
Experimental data: Representation methods and analysis, uncertainties. (09 hours)

Text Books:

1. Thomas G Beckwith, Roy D Marangoni, John H. Lienhard V, “Mechanical Measurements”, Pearson Education Asia, 2001.
2. Ernest O.Doebelin,”Measurement Systems (Application and Design)”, McGraw Hill.

Reference Books:

1. B.C.Nakra and K. K. Chaudhry, “Instrumentation, Measurement and Analysis”, 3rd Edition, Tata McGraw Hill, 2009.
2. J. P. Holman, “Experimental Methods for Engineers”, Tata McGraw Hill, 2000.
3. Subas Chandra Mukhopadhyay., “Intelligent Sensing, Instrumentation and Measurements”, www.springer.com, 2013.
4. www.nptel.ac.in

MEP51 MANUFACTURING PROCESS LABORATORY – III (0 0 3 2)

OBJECTIVES

To train the students in foundry practices, gear cutting, tool grinding and CNC programming.

LIST OF EXPERIMENTS

FOUNDRY:

1. Study of foundry tools
2. Mould preparation using solid patterns
3. Mould preparation using split patterns

GEAR CUTTING:

4. Study of gear hobbing machine
5. Spur gear hobbing
6. Spur gear milling
7. Helical gear milling

TOOL GRINDING:

8. Study of tool and cutter grinder
9. Grinding of single point cutting tool

CNC PROGRAMMING:

10. Study of CNC turning and milling machines
11. CNC Part Programming for turning
12. CNC Part Programming for milling
13. APT Programming for drilling
14. APT Programming for milling

MEP52 MECHANICAL MEASUREMENTS AND METROLOGY LABORATORY (0032)

OBJECTIVES

- *To get the practical knowledge in metrology and mechanical measurement techniques.*
- *To get hand-on experience on handling different measurement instruments and metrology devices.*

SUGGESTED LIST OF EXPERIMENTS

1. Calibration of Micrometer.
2. Measurement of taper using Sine Bar.
3. Calibration of Plain Plug Gauge.
4. Straightness and Flatness Measurement using Autocollimator.
5. Surface Roughness Measurement (Talysurf method)
6. Inspection of Screw Threads (Effective Diameter).
7. Calibration of Inclined Tube Manometer.
8. Measurement of Pressure using Strain Gauges.
9. Determination of the Time Constant of Thermocouples.
10. Measurement of Force using Transducers.
11. Measurement of Strain using Strain Gauges.
12. Study of Displacement using LVDT and RVDT.
13. Vibration Measurement using Accelerometer.
14. Measurement of speed using stroboscope
15. Inspection of gear tooth profile using profile projectors
16. Tool Maker Microscope (inspection of screws)
17. Inspection of internal and external surfaces (C M M)

MEP53 COMPUTATIONAL METHODS LABORATORY (2 0 2 2)

OBJECTIVES

- *Introduce the students to the science of numerical computations*
- *Mastery of Numerical methods for solving numerically different kinds of problems in Engineering*

Write programmes in FORTRAN/C or C++ / MATLAB for the following:

i. Finding roots of the given non-linear equation with single variable using Newton Raphson Method

ii. Solution of system of linear equations using Gauss elimination / Gauss Seidel methods

iii. Matrix inversion by Gauss Jordan method

iv. Eigen values of matrix by power method

v. Solution of system of non linear equations using successive substitution method.

vi. Numerical single and double integration using trapezoidal and Simpson's one third rule.

vii. Newton forward and backward difference interpolation

viii. Fourth order Runge-Kutta method for solving first order ordinary differential equations

ix. Finite difference methods for solving second order differential equation.

x. Golden section method to find minimum of a single variable objective function

Reference Books:

1. Grewal B.S and Grewal J.S, Numerical methods in Engineering and Science, 9th edition, Khanna publisher, New Dehli, 2007
2. Press, W. H., et al, Numerical Recipes in Fortran 90, Cambridge University Press, 1996
3. Markus, A., Modern Fortran in Practice, Cambridge University Press, 2012
4. Gerald. C.F., and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 2006
5. Paul L. DeVries and Javier E. Hasbun, A First Course in Computational Physics, Jones and Bartlett Publishers, Boston, 2011.
6. William H. Press, Saul A. Teukolsky, William T. Vetterling and Brian P. Flannery, Numerical Recipes: The Art of Scientific Computing, Cambridge University Press, 2007.

Web Resources:

1. https://www.coursera.org/course/scicomp
2. http://nptel.ac.in/courses/101104013/
3. http://ocw.mit.edu/courses/mathematics/18-335j-introduction-to-numerical-methods-fall-2010

MEP54 GENERAL PROFICIENCY- I (0 0 3 2)

OBJECTIVES

- *To hone the communication and non verbal skills of the students*
- *To improve their Listening, Speaking, Reading and writing skills of students*
- *To help the students to get rid of the inhibitions and communicate with ease.*
- *To enhance the employability prospects of students*
- *To ensure the personality development of the students by sharpening their soft skills*
- *To facilitate the students' entry into industry by grooming them holistically*

UNIT -I: ART OF COMMUNICATION

Verbal and Non-verbal Communication – Barriers to Communication – Importance of Body Language – Effective Listening – Feedback.

UNIT - II: INTRODUCATION TO SOFT SKILLS

Attitude – Self-Confidence – Leadership Qualities – Emotional Quotient – Effective Time
Management Skills – Surviving Stress – Overcoming Failure – Professional Ethics – Interpersonal Skills.

UNIT – III: WRITING

Importance of Writing – Written Vs Spoken Language – Formal and Informal Styles of writing – Resources for improving writing – Grammar and Usage – Vocabulary Building – SWOT analysis.

UNIT – IV: SPEAKING PRACTICE

Dialogue – Telephone Etiquette – Public Speaking – Debate – Informal Discussions – Presentations.

UNIT – V: APTITUDE

Verbal and Numerical aptitude.

References:

1. Nicholls, Anne. Mastering Public Speaking. Jaico Publishing House,2003.
2. Aggarwal, R.S. Quantitative Aptitude. S.Chand &Co.,2004.
3. Leigh, Andrew and Michael Maynard. The Perfect Leader. Random House Business Books, 1999.
4. Whetton .A.David and Kim S. Cameron. Developing Management Skills. Pearson Education, 2007.
5. K.R. Lakshminarayan. Developing Soft Skills. Scitech, 2009.
6. Sherfield M Robert. Developing Soft Skills Pearson Education, 2005.
7. Hair O' Dan, Friedrich W. Gustav and Lynda Dee Dixon. Strategic Communication in Business and the Professions. Pearson Education, 2008.
8. Chaney Lilian and Jeanette Martin. Intercultural Business Communication, Fourth Edition. Pearson Education, 2008.

MET61 OPERATIONS RESEARCH (3 1 0 4)

OBJECTIVES

- *To create awareness about optimization in utilization of resources.*
- *To understand and apply operations research techniques to industrial operation*
- *To introduce students to use quantitative methods and techniques for effective*
- *Decisions–making; model formulation and applications that are used in solving business decision problems.*

UNIT – I

Linear Programming Problems - Formulation and Duality concepts. Methods of solving LPP - Graphical Method, Simplex method (Computational Procedure) - Two Phase, Dual Simplex - Sensitivity analysis. Integer Programming: Introduction - Cutting plane method. (09 hours)

UNIT – II

Revised Simplex method - Transportation problem - optimal solution - MODI method - Transshipment problem. Assignment problem - various types. Dynamic programming - Solving General allocation, Investment, Stagecoach, Equipment replacement problems. (09 hours)

UNIT – III

Inventory Control Fundamentals-Inventory concepts and costs, Deterministic Inventory models - Single item models-Classic EOQ and gradual replacement / manufacturing models with and without shortages, EOQ with price breaks, Introduction to inventory control applications.
Game theory- Two persons zero sum games- Pure strategies, Mixed strategies, Dominance property, Graphical solution of (2xn) and (mx2) games. (09 hours)

UNIT – IV

PERT and CPM - Network diagram, Critical path, Crashing, probability considerations, Resource leveling and allocation. (09 hours)

UNIT – V

Waiting line problems - Poisson arrivals and exponential service times, single channel and single stage problems. Logical flow charts for single server and Parallel server Queuing Models. (09 hours)

Text Books:

1. R Pannerselvam, Operations Research, PHI Learning Private Ltd., New Delhi, 2008
2. Hamdy A.Taha, Operations Research - An Introduction, Prentice Hall of India, 1995.
3. P.K.Gupta and D.S.Hira, Operations Research, S.Chand & Sons Ltd., New Delhi, 2007.

Reference Book:

1. Harvey M.Wagner, Principles of Operations Research with applications to managerial decisions, Prentice Hall of India, 2001.

MET62 DESIGN OF TRANSMISSION SYSTEMS (3 1 0 4)

OBJECTIVES

To study about various mechanical transmissions systems and design of bearings, chains and ropes. To have a better understanding of gears and design of spur gears, helical gears, herring bone gears, straight and spiral bevel gears, worm gears and skew gears. To design the gear box, speed reducers, speed diagrams and stepped pulley.

UNIT – I

Theory of hydrodynamic bearing –design of journal bearing – heat dissipation – elementary ideas of hydrostatic bearings – bearing materials and lubricants.
Rolling contact bearings – load capacity and life – selection of rolling contact bearings for radial and axial loads. (09 hours)

UNIT – II

Belt drives – types – selection and design of flat and V-belts
Chain drives – roller chains – polygonal effect – sprocket wheels – silent chain.
(09 hours)

UNIT – III

Advantage of gear drives over other drives, nomenclature, failures of gear tooth, design of gears – based on bending and wears criteria – based on Lewis and Buckingham equation. (09 hours)

UNIT – IV

Bevel gears - nomenclature, design of gears – based on bending and wear criteria– based on Lewis and Buckingham equation, worm and worm wheel – nomenclature – design procedure. (09 hours)

UNIT – V

Geometric progression – standard step ratio – ray diagram, kinematics layout – design of sliding mesh gear box – constant mesh gear box – design of multi speed gear box. Speed reducer – design of speed reducer using spur and helical gears. (09 hours)

Text books:

1. T.J.Prabhu, Design of transmission elements, Madras book house, Chennai, 1997.
2. T.J.Prabhu, Fundamentals of machine design, Madras book house, Chennai, 1997.

Reference Books:

1. J.E.Shigley, Mechanical engineering design, I metric edition, McGraw Hill International Edition, 2011.
2. S.K.Basu, Design of machine tools, Oxford & IBH., 1990.
3. Sadhu singh, Machine design, Khanna publishers, 2001.
4. R.B.Gupta, Auto Design, Satya prakashan, 1990.

E-learning sources:

1. www.nptel.iitm.ac.in

MET63 THERMAL ENGINEERING (3 1 0 4)

OBJECTIVES

- *Study of IC engines and propulsion system*
- *Study of combustion in IC engines*
- *Understanding of emission, its impact on environment and control*
- *Study of compressible fluid flow*

UNIT - I

Classification of IC engines – petrol and diesel engines; two stroke and four stroke engines – scavenging in two stroke engines - port and valve timing diagram - fuel supply system in SI and CI engines - ignition system and its types – cooling system and its types – lubrication system and its types - lubricants - governing of IC engines – engine operating characteristics – power – cruising – idle and low engine speed – high engine speed – cold start - performance characteristics – heat balance test for IC engines (09 hours)

UNIT - II

Fuels: liquid and gaseous fuel and their characteristics –desirable properties of fuels for SI and CI engines– flash point, fire point, calorific value, Combustion process in IC engines – Flame propagation, normal and abnormal combustion, delay period, knocking and detonation, knocking rate of fuel, cetane number, octane number, supercharging and turbo charging – combustion chamber and types.Engine emission – formation of nitrogen oxides, carbon monoxide, hydrocarbon and particulates-emission standards

(09 hours)

UNIT – III

Basic principles – stagnation properties – sonic velocity – Mach number – and mach waves – Isentropic flow through variable area - Mach number variation – stagnation and critical states – area ratio as a function of Mach number, mass flow rate, flow through nozzles and diffusers. (09 hours)

UNIT - IV

Normal shocks – development of a shock wave, governing equations, Mach number after the shock, pressure and temperature across the shock. Oblique shocks – Nature of flow through Oblique shock waves, fundamental relations and equations, flow in constant area ducts with friction, flow in constant area ducts with heat transfer – multidimensional flows. (09 hours)

UNIT –V

Principle of jet propulsion – air craft jet engines – jet engine cycle – turbojet – turbofan – turboprop – turbofan engines - engine performance – thrust and efficiency, thrust power, propulsion power, propulsion efficiency and thermal efficiency – engine-aircraft matching. Rocket engines – introduction – space missions (09 hours)

Text Books:

1. Collin R. Ferguson–Internal Combustion Engines-Applied Thermo sciences, Wiley, 2004.
2. Yahya S.M., Fundamentals of Compressible Flow, New Age International, New Delhi, 2012.
3. Hill P. and Peterson C., Mechanics and Thermodynamics of Propulsion, Pearson Education, 2012.

Reference Books:

1. Willard W. Pulkrabek– Internal Combustion Engines, Prentice Hall of India, 2002.
2. J.B. Heywood– Internal Combustion Engines – fundamentals, McGraw Hill, 1988.
3. Cambel, A.B. and Jennings, 'Gas dynamics and Compressible Flow", Tata McGraw Hill, 1958.
4. V. Ganesan – Internal Combustion Engines, Tata McGraw Hill, 1999.

Web Resources:

1. https://www.coursera.org/course/introthermodynamics
2. http://nptel.ac.in/courses/112104033

http://ocw.mit.edu/courses/mechanical-engineering/2-61-internal-combustion-engines-spring-2008

MET64 COMPUTER INTEGRATED MANUFACTURING (4 0 0 4)

OBJECTIVES

- *On completion of the course the students are expected to be knowledgeable in converting design information in to manufacturing planning and manufacturing control.*
- *To gain knowledge on how computers are integrated at various levels of planning and manufacturing and understand the concept of computer networking, CAD/CAM integration, computer process planning and production planning.*
- *To gain knowledge about the fundamental concept of product design, simultaneous/concurrent engineering and reverse engineering.*
- *To understand the database manufacturing system and to handle the product data and various software used for manufacturing and effectively implemented in manufacturing organizations.*

UNIT – I

CIM: Introduction to CIM, CIM Wheel, Evolution, Benefits, Trends. Computers in Manufacturing: Factory tasks for Computer Integration – Needs of CIM, CIM Hardware and Software, Workstations.
Fundamentals of Communication: Communications Matrix – Types. Representation of data, Coding, Transmission, Medium, Types of Communication Lines and Hardware. Network Architectures: The seven layers – OSI Model, LAN, MAP and Network Topologies. (09 hours)

UNIT – II

Data base: Introduction – Manufacturing data- Data base models, Data base Management – Data base required for a shop floor control (Fundamentals only)
Product Design: Design Process, Design for Manufacturability, CAD – areas of Application, Benefits, CAD to CAM, CAE (Fundamentals only) (09 hours)

UNIT – III

Concurrent / Simultaneous engineering: Introduction, Design for manufacturing and assembly, and other product design objectives. Advanced Manufacturing Planning. Introduction to Reverse Engineering.
Process Planning: CAPP – Retrieval and Generative Model. (09 hours)

UNIT – IV

Production Planning and Control: Computerized PPL, Aggregate Production Planning, MPS, MRP, MRP II, ERP and JIT. Automated Data Collection – Bar Codes, OCR, Image Processing, RF Identification, Magnetic Identification, Voice Technology, Comparison, Control Types. (09 hours)

UNIT – V

Quality: Modern Concepts, TQM, TPM – ISO Standards, CAQC – Contact & Non – Contact type, Introduction to CMM – Types
Inspection: Description, Working Principle and Application of Various Techniques and Equipments. Interfacing inspection with CAD/CAM. (09 hours)

Text Books

1. Mikell. P. Groover, Automation, Production Systems and computer integrated manufacturing, Prentice Hall of India, New Delhi, 2007.
2. P. Radhakrishnan , S. Subramanyan and V. Raju, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi, 2000

References

1. S. Kant Vajpayee, Principles of Computer Integrated Manufacturing, Prentice Hall of India, 2003.
2. Roger Hanman, Computer Intergrated Manufacturing, Addison – Wesley, 1995.

Web reference

1. www.cimlearningzone.co.uk/
2. http://nptel.ac.in/courses/112102101/
3. http://nptel.ac.in/courses/112102103/
4. http://elearning.vtu.ac.in/06ME72.html
1.

MET65 CONTROL SYSTEM ENGINEERING (3 1 0 4)

OBJECTIVES

- *To introduce to the basics of Control System Engineering as part of life.*
- *To make aware of different tools and duties of Control System Engineer.*
- *To conversant with Mathematical Modeling of Physical Systems.*
- *To convey the concepts to analyze the simple systems in time and frequency domain.*
- *To introduce to Modern Control Systems*

UNIT – I

Introduction to Control Engineering –Examples – as part of life - Basic Components of Control System –Different tools for Control Engineer - Open loop and Closed loop system –Introduction to Mathematical Modeling - Transfer Functions. (09 hours)

UNIT – II

Modeling of Physical Systems – Mechanical, Thermal, Fluid and Electrical systems – Block Diagram reduction Techniques – Introduction to Time Domain Analysis – Standard Test Signals. (09 hours)

UNIT – III

Response of First Order Systems and Second Order Systems for different standard input signals - Sources of errors: static and dynamic error constants. Design Specification for Control Systems – PD, PI and PID Controllers. (09 hours)

UNIT – IV

Poles and Zeros – Stability of Systems – Conditions for Stability – Routh – Hurwitz Stability Criterion – Root Locus Analysis – Properties – Root Locus Plots. (09 hours)

UNIT – V

Frequency Response of Control Systems – Correlation Between Time Response and Frequency Response – Bode Plot – Nyquist Stability Criterion and Closed Loop Frequency Response – Introduction to control using state variable system models – Transfer function from State Model. (09 hours)

Text Books:

1. Jacqueline Wilkie, Michael Johnson and Reza Katebi – Control Engineering – An Introductory course. PALGRAVE (2002).
2. N.C. Jagan – Control Systems – BS Publications (2008).
3. Katsushiks Ogata - Modern Control Engineering, IV Edition, Prentice Hall of India, 2002.

Reference Books:

1. B.C.Kuo - Automatic Control System, VII edition, Prentice Hall of India, 2002.
2. Asish Tewari – Modern Control Design with MATLAB and SIMULINK – John Wiley & Sons, Ltd., 2002.
3. Norman S. Nice – Control Systems Engineering - John Wiley & Sons, Inc., 2011.

MEP61 THERMAL ENGINEERING LABORATORY – I (0 0 3 2)

OBJECTIVES

- *To make the students to understand the different properties of fuels like flash point fire point, viscosity, calorific value etc and the principle of measurement.*
- *To teach the students principle of working of air compressors and blowers*
- *To teach the students the different modes of heat transfer like natural convection, forced convection and the use of fins*
- *To teach the students the composition of exhaust gases and their analysis using Orsat apparatus*
- *To teach the students the principle of parallel flow and counter flow heat exchangers.*

SUGGESTED LIST OF EXPERIMENTS

1. Determination of Kinematic Viscosity using Redwood viscometer
2. Determination of flash point using Pensky- Martin closed cup apparatus.
3. Determination of flash and fire point using Cleaveland apparatus
4. Determination of calorific value of solid fuel using bomb calorimeter
5. Determination of calorific value of gaseous fuel using Junker's gas calorimeter
6. Performance test on reciprocating air compressor
7. Performance test on centrifugal air blower
8. Determination of thermal resistance and conductivity of a composite wall
9. Determination of heat transfer coefficient for heat transfer from cylindrical surface by natural convection
10. Determination of heat transfer coefficient for heat transfer from cylindrical surface by forced convection
11. Determination of heat transfer coefficient for heat transfer from pin fin by forced convection
12. Performance of parallel flow/counter flow heat exchanger

MEP62 DYNAMICS OF MACHINES LABORATORY (0 0 3 2)

OBJECTIVES

- *To make the students to understand the different properties of fuels like flash point fire point, viscosity, calorific value etc and the principle of measurement.*
- *To teach the students principle of working of various governor.*
- *To teach the students the different modes of balancing*
- *To teach the students, various modes of vibration.*

SUGGESTED LIST OF EXPERIMENTS

1. Demonstration of four bar inversion mechanism
2. Natural frequency of single mass, single helical spring system.
3. Natural frequency of combination of springs – springs in parallel, springs in series
4. Natural frequency of undamped torsional single rotor, double rotor system. Effect of inertia (I) and stiffness (k).
5. Determination of radius of gyration of a given compound pendulum
6. Determination of radius of gyration, moment of inertia – bifilar suspension method – trifilar suspension method
7. Damping coefficient of torsional single rotor system – Effect of depth of immersion in oil and damping ratio
8. Resonance frequency of equivalent spring mass system – undamped and damped condition
    a) To plot amplitude Vs frequency graph for different damping.
9. Determination of characteristic curves of Watt, Porter, Proell and spring loaded governors.
10. Static and Dynamic balancing.
11. Whirling of shafts/ determination of critical speed with and without Rotors.
12. Gyroscopic couple verification.
13. Journal bearing – pressure distribution of different loads at different Speeds.
14. Cam motion analysis.
15. Generation of involute gear profile.
16. Tracing of coupler curves.
17. Determination of error in straight line drawn by watt chain mechanism.

MEP63 COMPUTATIONAL FLUID DYNAMICS LABORATORY (0 0 3 2)

OBJECTIVES

- *Introduce the students to the science of computational fluid dynamics and heat transfer*
- *Familiarity with pre and post processing steps in CFD study*
- *Using physics based simulation for computer aided design and engineering*
- *Grid generation and boundary conditions for complex geometry*
- *Understanding the multi physical simulation approach for phenomena under investigation*
- *Design Optimization using CFD*

Geometry and Grid Generation - SaloME
Solver - OpenFOAM
Analysis of Results - Para View

1. 2D and 3D structured grid generation – flat plates, aerofoil
2. 3D unstructured grid generation – pipe, external aerodynamics
3. Incompressible internal laminar flows
4. Incompressible external laminar flows
5. Incompressible internal turbulent flows
6. Incompressible external turbulent flows
7. Forced Convection flows
8. Buoyancy driven flows
9. Multiphase flows - Capillary driven
10. Compressible flows
11. Non Newtonian and Biological flows
12. Fluid Structure Interaction

Reference Books:

1. OpenFOAM 2.3.0 User Manual, 2014.
2. Salome 7.4.0 User Manual, 2014.
3. ParaView 4.2.0 User Manual, 2014.

Web Resources:

1. https://www.coursera.org/course/spobuildaerodynamics
2. http://nptel.ac.in/courses/101106045
3. http://ocw.mit.edu/courses/aeronautics-and-astronautics/16-100-aerodynamics-fall-2005

MEP64 GENERAL PROFICIENCY – II (0 0 3 2)

OBJECTIVES

- *To develop the students' critical thinking and analytical skills*
- *To help the students to equip themselves with the necessary skill sets.*
- *To improve the students' problem solving skills*
- *To help the students to prepare for interviews and face them with confidence.*
- *To make the students industry- ready and employable.*
- *To enable the students to be more participative in Group Discussions and other activities*

UNIT – I: COMPOSITION ANALYSIS

Technical and Non- Technical Passages (GRE Based)- Differences in American and British English- Analyzing Contemporary issues- Expanding Terminology

UNIT - II: WRITING

Job Application Letter- Resume Writing

UNIT – III: ORAL SKILLS

Group Discussion- Introduction and Practice- Team work- Negotiation skills- Organising and attending meetings- Facing Interviews

UNIT - IV: ADAPTING TO CORPORATE LIFE

Corporate Etiquette- Grooming and Dressing

UNIT - V: Aptitude

Verbal and Numerical Aptitude

Reference Books:

1. Pushplata and Sanjay Kumar. Communicate or Collapse: A Handbook of effective public speaking, Group Discussions and Interviews. Prentice Hall, New Delhi, 2007.
2. Thorpe, Edgar. Course in Mental Ability and Quantitative Aptitude**.** Tata McGraw, 2003.
3. Thorpe, Edgar. Test of Reasoning. Tata McGraw, 2003.
4. Prasad, H.M. How to prepare for Group Discussion and Interview. Tata McGraw, 2001.
5. Career Press Editors, 101 Great Resumes. Jaico Publishing House, 2003.
6. Aggarwal, R.S. A Modern Approach to Verbal and Non Verbal Reasoning. S. Chand & Co., 2004.
7. Mishra Sunita and Muralikrishna. Communication Skills for Engineers. First Edition. Pearson Education, 2004.

MET71 COMPUTER AIDED DESIGN (3 1 0 4)

OBJECTIVES

- *To understand the principles of Graphics*
- *To develop the knowledge of computer assisted drawing and modeling techniques*

UNIT – I

Design process - Morphology of design, Types of design models, Application of design models, concurrent Engineering – CAD system architecture.
CAD Hardware: workstation – CPU, mass storage, input devices (keyboard, light pen, thumb wheel joy stick, mouse, digitizer etc.,) and output devices (printers, plotters)
Display Devices: storage tube – raster scan, vector refresh, plasma panel and LCD.
(09 hours)

UNIT – II

Bresenham's line and circle algorithms. Transformation in Graphics: co-ordinate system used in Graphics and windowing and view port transformations, Clipping , hidden line elimination, 2D transformations – rotation, scaling, translation, mirror, reflection and shear – homogeneous transformations – concatenation, 3D Transformation – orthographic and Perspective Projections. (09 hours)

UNIT – III

Classification of Geometric Modeling – Wire frame, Surface and Solid Modeling, applications – representation of curves and surfaces – Parametric form – Design of curved shapes- Cubic spline –Bezier curve – B-spline – Design of Surfaces - features of Surface Modeling Package – Solid Primitives, CSG, B-rep and description of other modeling techniques like Pure primitive instancing, cell decomposition, spatial occupancy enumeration, Boolean Operations (join, cut, intersection), Creating 3D objects from 2D profiles (extrusion, revolving etc) (09 hours)

UNIT – IV

Hidden line-surface-solid removal algorithm-shading-colouring-animation
Parametric and variational modeling, Feature based modeling, An overview of modeling software like PRO-E, CATIA, IDEAS, SOLID EDGE and other advanced Softwares. (09 hours)

UNIT – V

Standards for computer graphics (GKS) and Data exchange standards – IGES, STEP. Standard for exchange images (open GL) Data structures for Entity storage – Data structures for interactive modelling- Relational databases
(09 hours)

Text Books:

1. Chris Mcmahon and Jimmie Browne - CAD/CAM – Principle Practice and Manufacturing Management, 2nd Edition, Addison Wesley England, 2000.
2. Sadhu Singh - Computer Aided Design and Manufacturing, II Edition, Khanna Publishers, New Delhi, 2008.

Reference Books:

1. P.Radhakrishnan et al - CAD/CAM/CIM, New Age International P Ltd., New Delhi, 2006.
2. M.P.Groover and E.W.Zimmers - CAD/CAM; Computer Aided Design and Manufacturing, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2006.
3. Ibrahim Zeid - CAD/CAM Theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2005.

MET72 INDUSTRIAL ENGINEERING AND MANAGEMENT (4 0 0 4)

OBJECTIVES

- To provide the students knowledge of productivity techniques and systems, industrial engineering and management disciplines so as to fully equip them to take up challenging assignments as industrial engineers, systems managers, productivity advisers, managers of management services or training officers

COURSE OUTCOMES

Upon completion of the course, the students will

1. Competently employ broad-based analytical tools and computers for decision-making and system design, analysis and performance
2. Assume managerial and leadership roles in their chosen professional careers while working in multidisciplinary teams.
3. Engage in continuous learning by seeking out opportunities for higher education or ongoing training related to their employment.
4. Effectively adapt to the changing demands in workplace and are able to perform increasingly complex tasks, and tasks outside their field of expertise.

SYLLABUS:

Unit I : Plant Location, Layout and Material Handling

Plant Location : influencing factors - evaluation of location alternatives for Single facility location problems – solving simple problems.

Plant Layout : classification of production systems – principles of layout – basic types of layout – line balancing – simple problems in line balancing using Ranking Positional Weight Method.

Material Handling : functions – principles – classification of material handling equipments (only classification and no description) - factors to be considered in selection of material handling equipment. (9 hours)

Unit II : Work Study

Method Study : objectives - basic procedure - various recording techniques – process charts, multiple activity charts, SIMO chart, Flow diagram, string diagram, cyclegraph and chronocyclegraph - principles of motion economy – Therbligs - micromotion study & memomotion study.

Work Measurement : purpose - basic procedure – various techniques of work measurement – analytical estimation – stop watch time study – time study equipments – different systems of performance rating – time allowances – PMTS - work sampling – simple problems involving the determination of standard time and compensation.

(9 hours)

Unit-III : Production Planning and Control

Production Planning and Control : functions – qualitative and quantitative techniques of forecasting – simple problems in forecasting using moving average, weighted moving average, simple exponential smoothing and regression methods - routing – loading and scheduling – different methods of scheduling – expediting – dispatching – functions and objectives of materials management – Introduction to inventory control and ABC analysis.

(9 hours)

Unit IV : General and Financial Management

Management : Basic Concepts – Introduction to modern management – Taylor's contribution - Fayol's principles - functions of management.

Financial Management : fixed and working capital - sources of finance - evaluation of investment alternatives using present worth / future worth / annuity / rate of return

methods – different methods of determining depreciation – Elements of cost & cost ladder - break-even analysis – simple problems. (9 hours)

Unit V : Marketing and Human Resources Management

Marketing Management : Concepts of Marketing - products and markets – pricing - channels of distribution - sales promotion - advertising - basics of market research.

Human Resources Management : individual and group behaviour – Maslow's hierarchy of needs – motivation and morale - fatigue - causes & remedy - manpower planning – job analysis – job evaluation and merit rating - management by objectives (MBO). (9 hours)

TEXT BOOKS :

1. R.Panneerselvam - Production and Operations Management, PHI Learning Pvt. Ltd., 2nd Edition, 2006.
2. Martand Telsang - Industrial Engineering and Production Management, S.Chand & Co., 2nd Revised Edition, 2006.
3. O.P.Khanna - Industrial Engineering and Management, Dhanpat Rai Sons (P) Ltd., 2010.

REFERENCE BOOKS :

1. Joseph Monks - Operations Management: Theory and Problems, McGraw Hill Education, ISE Edition, 1987.
2. R.M.Barnes - Motion and Time Study: design and Measurement of Work, John Wiley & Sons, 7th Edition, 1980.
3. Roger G.Schroeder Susan Meyer Goldstein and M. Johnny Rungtusanatham - Operations Management : Contemporary Concepts and cases, McGraw Hill, New York, 5th Edition, 2011.

E LEARNING RESOURCES :

1. www.nptel.ac.in
2. Mark Lehto and Steven J Landry - Introduction to Human Factors and Ergonomics for Engineers, CRC Press, 2nd Edition, 2013.
3. Suresh P Sethi, Marija Pogatas and Lorenzo Ros-McDonell (Editors) – Industrial Engineering: Innovative Networks, Springer Verlog London Limited, 2012.
4. S.B.Patil, A.A.Karad and P.B.Kushare – Industrial Engineering & Management, Technical Publications Pune, 1st Edition, 2008.
5. Gavriel Salvendy (Ed.) - Handbook of Industrial Engineering: Technology and Operations Management, John Wiley & Sons, 3rd Edition, 2001.
6. Kjell B Zandin - Maynard's Industrial Engineering Handbook, John Wiley & Sons, 5th Edition, 2001.

MET73 REFRIGERATION, AIR CONDITIONING AND CRYOGENIC ENGINEERING (3 1 0 4)

OBJECTIVES

- *To expose to different methods of refrigeration*
- *To disseminate the operation of various types of refrigeration systems*
- *To build up an intuitive understanding of operation of air-conditioning systems*
- *To develop ability to estimate capacity of any air-conditioner*
- *To understand the basics of cryogenics and operation of cryogenic systems*

UNIT - I: REFRIGERATION

Basics of refrigeration – Methods of refrigeration: ice refrigeration, evaporative refrigeration, expansion cooling, throttling – Unit of refrigeration – vapour compression refrigeration system- p-h and T-s diagrams- deviations from theoretical cycle – sub-cooling and super heating- effects of condenser and evaporator pressure on COP- Refrigerants: primary and secondary refrigerants –Properties of refrigerants – Selection of refrigerants- Nomenclature - ODP & GWP (09 hours)

UNIT II OTHER REFRIGERATION SYSTEMS

Vapour absorption refrigeration system- Working pairs of absorption refrigeration system – vapour jet refrigeration system, thermoelectric refrigeration system, Air refrigeration system, vortex tube refrigeration, pulse tube refrigeration and adiabatic demagnetization cooling (09 hours)

UNIT - III: PSYCHROMETRY AND AIR-CONDITIONING

Psychrometry and psychrometric properties – Psychrometric Chart- Psychrometric relations: Dalton's law of partial pressures – Wet bulb temperature and measurement – Adiabatic saturation temperature – Psychrometric processes – Air-conditioning systems: summer air-conditioning and winter air-conditioning – Requirement for comfort air-conditioning – Factors governing human comfort – Comfort chart.
(09 hours)

UNIT - IV: COOLING LOAD AND DESIGN OF AIR-CONDITIONING SYSTEMS

Sources of heat load – Conduction load – Sun load – Load from occupants – Equipment load – Infiltration air-load – Load from moisture gain – Fresh air load – ASHRAE standards – Calculation of load on air-conditioning system – Methods of air-conditioning system: Centralized air-conditioning system, unitary air-conditioning system and direct air-conditioning system – Air-conditioning devices and equipment: air cleaners, air filters, humidifiers, dehumidifiers, fans and blowers – cooling towers.
(09 hours)

UNIT -V: CRYOGENICS LIQUEFACTION AND REFRIGERATION SYSTEMS

Introduction to cryogenics – Applications involving cryogenic engineering – Cryogenic fluids and properties – Production of low temperature: Joule-Thomson effect – Inversion curve – Adiabatic expansion – Cryogenic liquefaction systems: Linde-Hampson system, pre-cooled Linde-Hampson system, Linde dual pressure system, Claude system, pre-cooled Claude system, Kapitza system, Heylandt system, Collin's helium-liquefaction system and Simon helium-liquefaction system. Joule - Thomson refrigeration system – Cascade Joule -Thomson refrigeration system – Expansion - engine refrigeration system – Cold gas refrigeration system – Philips refrigerator – Solvay refrigerator – A. D. Little refrigerator – Vuilleumier refrigerator.
(09 hours)

Reference books:

1. Arora, C. P., Refrigeration and Air conditioning, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2000
2. Stoecker, W. F. and Jones, J. W., Refrigeration and Air conditioning, McGraw Hill Book Publishing Co. Ltd., New York, 1995
3. ASHRAE Equipment Handbook, The American Society of Heating, Refrigerating and Air-conditioning Engineers Inc., Atlanta, Georgia, 2001
4. Randall Barron, Cryogenic Systems, McGraw Hill Book Publishing Co. Ltd., New York, 1966
5. Timmerhaus, K. D. and Flynn, T. M., Cryogenic Process Engineering, Plenum Press, New York, 1989

MEP71 THERMAL ENGINEERING LABORATORY - II (0 0 3 2)

OBJECTIVES

- *To make the students to understand the principle of working of internal combustion engines and make them to do performance test on petrol engines and diesel engines.*
- *To make them to understand the load test and heat balance test on IC engines.*
- *To make them familiarize with different components of petrol and diesel engines*
- *To make the students to understand the use of different types of dynamometers, loading devices and take readings like volumetric flow rate of fuel, air etc.*
- *To make the students to do calculations and determine specific fuel consumption, indicated power, brake power, friction power, thermal efficiency, mechanical efficiency air-fuel ratio etc and draw the performance curves and draw the heat balance chart.*
- *To enable the students to understand the principles of working of refrigeration/ air-conditioning system and familiarize the different components of it.*
- *To enable the students to take readings on the refrigeration system/ air-conditioning and determine COP.*
- *To enable the students to understand the principles of working of cooling tower and familiarize the different components of it.*
- *To enable the students to understand the principle of working of boilers, steam turbine and take readings on these systems*

Suggested List of Experiments:

1. Valve and port timing diagrams of 4-stroke and 2-stroke IC engines respectively
2. Performance test on single cylinder 4- stroke petrol engine.
3. Performance test on multi-cylinder 4- stroke petrol engine
4. Performance test on single cylinder 4- stroke diesel engine
5. Performance test on multi-cylinder 4- stroke diesel engine
6. Heat balance test on IC engines
7. Engine exhaust gas analysis using Orsat apparatus
8. Performance test on cooling tower.
9. Performance test on refrigeration system.
10. Performance test on air-conditioning system.
11. Performance test on vapour absorption refrigeration system
12. Performance test on a boiler.
13. Performance test on steam turbine.
14. Determination of dryness fraction of steam using calorimeter.

MEP72 COMPUTER AIDED ENGINEERING LABORATORY (0 0 3 2)

OBJECTIVES

- *To give exposure to students about computer aided design and modeling & analysis softwares*

PART – A

COMPUTER AIDED DESIGN OF MACHINE COMPONENTS

Design and drafting of the following components using TK SOLVER/ FORTRAN / C or C++/ Matlab

- Transmission shafts,
- Journal bearings,
- Flange couplings etc.

PART-B:

I. 3D MODELLING

1) Introduction to 3-D modeling– sketcher, part design, assembly and drafting workbenches.
2) Generation of various 3D Models through Protrusion, revolve, shell sweep.
3) Feature based and Boolean based modeling surfaces.
4) Assembly modeling of components having a minimum of six machine elements.

[Minimum of two exercises in part modeling and one exercise in assembly]

II. FE Analysis:

Using any of the general purpose FEA software packages solve for

1) Force and stress analysis in trusses
2) SF and BMD diagrams for different types of beams with different loading and boundary conditions.
3) Stress concentration study on plate with central hole
4) Thermal stress and heat transfer analysis of a simple plate.

Note: In university practical examination, students has to answer one question each from Part A and Part B.

MEP73 COMPREHENSIVE VIVA – VOCE (0 0 3 2)

The student will be tested for his understanding of basic principles of the core Mechanical Engineering subjects. The internal assessment for a total of 50 marks will be made by an internal assessment committee. The committee will conduct two written examinations of objective or short questions type from all the core subjects.

The external university examination, which carries a total of 50 marks, will be a Viva Voce examination conducted by a committee of one external examiner and one internal examiner appointed by the University.

MEP74 INDUSTRIAL VISITS / TRAINING REPORT (0 0 0 1)

During the course of study from 3rd to 7th semester each student is expected to undertake a minimum of four industrial visits or undertake a minimum of two weeks of industry/field training. The students are expected to submit a report, which shall be evaluated by an internal assessment committee at the end of seventh semester for 100 marks.

MEPW7 PROJECT WORK (PHASE I) (0 0 3 4)

The objective of the project is to enable the students to work in groups of not more than four members in each group on a project involving analytical, experimental , design or combination of these in the area of Mechanical Engineering. Each project shall have a guide. The student is required to do literature survey, formulate the problem and form a methodology of arriving at the solution of the problem. The evaluation is based on continuous internal assessment by an internal assessment committee. On completion of the Phase I work, a project report should be prepared and submitted to the department. The project work and the report will be evaluated by an internal assessment committee for 50 marks. The external university examination, which carries a total of 50 marks, will have report evaluation and viva voce examination conducted by a committee of one external examiner and one internal examiner appointed by the University.

MET81 POWER PLANT ENGINEERING (3 1 0 4)

OBJECTIVES

- *Introduce the students to fundamentals of power generation using fossil fuels namely coal, gas and liquid*
- *Familiarizing with the power generation terminology and performance figures*
- *Power plant equipment for fuel handling, steam generation, feed water, combustion air and flue gas*
- *Emission control through equipment and process modification*
- *Estimation of power costs through the Economics involved in power plant construction and operation*

UNIT – I

Power Scenario in India- Vapour power cycles - Rankine Cycle- Reheat cycle – Regenerative cycle – Reheat – regenerative cycle. Binary vapour cycle. Steam generators – modern high pressure generators- Accessories: Boiler Feed Pump, feed water heaters/economiser, air-preheaters, Superheaters, (09 hours)

UNIT – II

Air handling system: forced draught fans, primary and secondary air system for solid fuels – flue gas path; method of producing draught: natural, induced draughts – induced draught fans – flue gas treatment for pollution: particulate emissions and pollutants - cyclone separator, electro-static precipitator – chimney – calculation of chimney height - Bottom ash handling system. Cooling towers, Feed water treatment: demineralised water, treatment processes: mechanical, chemical processes – Duration – fuel handling system: solid fuels – pulveriserd fuels, liquid and gaseous fuels – supply system. (09 hours)

UNIT – III

steam nozzles – flow through nozzles – nozzle efficiency – Effect of super heating – supersaturated (or) metastable expansion of steam in a nozzle – steam turbines – classification – turbine blading - velocity diagrams – Compounding of impulse turbine – Reaction turbine - Blade profiles of impulse and reaction turbines (09 hours)

UNIT – IV

External combustion engines - Gas turbine plant cycle – classification – simple cycle – regenerative cycle – reheat cycle – regenerative – reheat cycle – inter-cooling. Combined cycles - Steam and gas turbine Power plants – cycle analysis - Nuclear fuels – coolants – moderators – radiation shield – Nuclear reactor - terminology: different types – Nuclear Power Plant Layout – Fuel requirements – Safety - Waste disposal – comparison with coal fired plant. (09 hours)

UNIT –V

Fluctuating loads – terms and definitions, load curves, effect of variable load, methods to meet variable load – peak load plants: demand, requirements and load analysis. Power plant economics: Terminology - growth rates – capital costs – operating costs – system power cost - Estimation of power costs – CWIP, AFUDC, Escalation, Taxes , selection of type of generation and equipment, economic analysis of performance and operating characteristics, methods of tariff for electrical energy. (09 hours)

Text Books:

1. W. Culp, Principles of Energy Conversion, Tata McGraw Hill, 2000.
2. P.K.Nag, Power Plant Engineering, Tata McGraw Hill, 2000.

Reference Books:

1. Frederick T.Morse, Power Plant Engineering, Affiliated East-west Press Ltd., 1953.
2. William A.Vapert, Power Station Engineering and Economy, Tata McGraw Hill, 1972.
3. M.D.Burghardt, Engineering Thermodynamics with Applications, Harper Row, 1986
4. El Wakil M M, Power Plant Technology, McGraw-hill Publications, 2002
5. P.K.Nag, Power Plant Engineering, Tata McGraw Hill, 2000.

Web Resources:

1. https://www.coursera.org/course/nuclearscience
2. http://nptel.ac.in/courses/103106101
3. http://ocw.mit.edu/courses/nuclear-engineering/22-312-engineering-of-nuclear-reactors-fall-2007

MET82 PROFESSIONAL ETHICS AND INDIAN CONSTITUTION (1 0 0 1)

The course should cover the following topics by way of Seminars, Expert Lectures and assignments:

1. Engineering Ethics – Moral issues, Ethical theories and their uses
2. Engineering as Experimentation – Code of Ethics
3. Engineer's responsibility for safety
4. Responsibilities and rights
5. Global issues of engineering ethics
6. Fundamental Rights and Constitution of India

References:

1. Charles D.Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 1999
2. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
4. World Community Service Centre, " Value Education", Vethathiri publications, Erode, 2011

MEPW8 PROJECT WORK (PHASE II)
(0 0 12 8)

Project work phase II will be an extension of the project work started in the seventh semester. On completion of the work, a project report should be prepared and submitted to the department. The project work and the report will be evaluated by an internal assessment committee for 50 marks. The external university examination, which carries a total of 50 marks, will have report evaluation and viva voce examination conducted by a committee of one external examiner and one internal examiner appointed by the University.

MEP81 SEMINAR (0 0 3 1)

Each one of the students will be assigned a Seminar Topic in the current and frontier areas. The student has to conduct a detailed study/survey on the assigned topic and prepare a report. The student will make an oral presentation followed by a brief question and answer session. The Seminar (presentation and report) will be evaluated by an internal assessment committee for a total of 100 marks.

ELECTIVE – I

MEE51 COMPUTATIONAL METHODS AND PROGRAMMING (4 0 0 4)

OBJECTIVES

- *To introduce and develop the main approaches and techniques that constitutes the basis of numerical fluid and solid mechanics for engineers and applied scientists.*
- *To familiarize students with the numerical implementation of these techniques and numerical schemes, so as to provide them with the means to write their own codes and software, and so acquire the knowledge necessary for the skillful utilization of CFD packages or other more complex software.*
- *To cover a range of modern approaches for numerical and computational fluid dynamics, without entering all these topics in detail, but aiming to provide students with a general knowledge and understanding of the subject, including recommendations for further studies.*

This course continues to be a work in progress. New curricular materials are being developed for this course, and feedback from students is always welcome and appreciated during the term. For example, recitations and reviews on specific topics can be provided based on requests from students.

UNIT-I: **INTRODUCTION TO MATHEMATICAL MODELING**

Mathematical model – introduction to programming and software – Excel, MATLAB – Accuracy and precision – error definitions – round off errors – error propagation – formulation errors and data uncertainty. (9 hours)

UNIT-II: **ROOTS OF EQUATIONS**

Bracketed methods- Bisection method, False-position method. Open methods – Newton Raphson method, Secant method, Brent's method. Roots of Polynomials – Muller's method, Bairstow's method. (9 hours)

UNIT-III: LINEAR ALGEBRAIC EQUATIONS

Gauss Elimination method- Gauss Jordan method – LU Decomposition method – Matrix Inverse method – Gauss Seidel method- Special matrices – error analysis. Curve fitting – least squares regression – Interpolation – Fourier approximation. (9 hours)

UNIT-IV: ORDINARY DIFFERENTIAL EQUATIONS (ODES)

Euler's method, Improved Euler's method, Runge-Kutta Methods, System of equation, Adaptive RK method, Stiffness and multistep methods – Boundary-value & Eigen Value problems. (9 hours)

UNIT-V: PARTIAL DIFFERENTIAL EQUATIONS (PDES)

Finite difference method –Elliptic – Laplace equation, solution techniques- Boundary conditions and control volume approach. Parabolic- Heat conduction equation, explicit methods, simple implicit methods, Crank-Nicolson method, 2-D equations, Finite Element method in 1-D problems. (9 hours)

Text Books:

1. Chapra, S., and R. Canale. Numerical Methods for Engineers. 6th ed. McGraw-Hill Higher Education, 2010. ISBN: 9780073401065.
2. Ferziger, J., and M. Peric. Computational Methods for Fluid Dynamics. 3rd ed. Springer, 2001. ISBN: 9783540420743.

3. Cebeci, T., J. Shao, et al. Computational Fluid Dynamics for Engineers: From Panel to Navier-Stokes Methods with Computer Programs. Springer, 2005. ISBN: 9783540244516.
4. Lomax, H., T. Pulliam, and D. Zingg. Fundamentals of Computational Fluid Dynamics (Scientific Computation). Springer, 2004. ISBN: 9783540416074.

Reference Books:

1. Kundu, P. K., and I. M. Cohen. Fluid Mechanics. 4th ed. Academic Press, 2007. ISBN: 9780123737359.
2. White, F. M. Fluid Mechanics. 7th ed. McGraw-Hill Companies Inc., 2010. ISBN: 9780077422417.
3. Chapra, S. C. Applied Numerical Methods with MATLAB for Engineers and Scientists. 3rd ed. McGraw-Hill Companies Inc., 2011. ISBN: 9780073401102.

Web Reference:

1. http://nptel.iitm.ac.in/courses.php
2. http://ocw.mit.edu/courses/
3. http://en.wikipedia.org

MEE52 DIRECT ENERGY CONVERSION SYSTEMS (4 0 0 4)

OBJECTIVES

- *Learn the fundamentals of energy conversion systems, available energy and the local and national needs, solar engineering applications, emerging technologies.*
- *Understand the interdisciplinary approach for designing stand-alone PV systems, predicting performance with different systems, implementing design with cost analysis.*
- *Gain system engineering expertise related to photovoltaic energy conversion: generation, storage, and grid connection processes for residential and industrial applications, and*
- *Learn how to advance the current technology of the solar energy systems for making the process economical, environmentally safe and sustainable. Be able to serve industries or academia involved in sustainable energy engineering.*

UNIT – I: CLASSIFICATION OF ENERGY SOURCES

Principle fuels for energy conversion: fossil fuels, nuclear fuels. Conventional & Renewable Energy Sources: prospecting, extraction and resource assessment and their peculiar characteristics. Direct use of primary energy sources, Conversion of primary into secondary energy sources such as electricity, hydrogen, nuclear energy, energy conversion through fission and fusion, nuclear power generation. (9 hours)

UNIT – II: WIND ENERGY

Wind Energy: Basics & Power Analysis, Wind resource assessment, Power Conversion Technologies and applications, Wind Power estimation techniques, Principles of Aerodynamics of wind turbine blade, various aspects of wind turbine design, Wind Turbine Generators: Induction, Synchronous machine, constant V & F and variable V & F generations, Reactive power compensation. Site Selection, Concept of wind form & project cycle, Cost economics & viability of wind farm. (9 hours)

UNIT – III: SOLAR PHOTOVOLTAIC CELL

Photovoltaic conversion – solar cell configurations – characteristics of solar cells- performance of solar cells - Thermoelectric converters – Thermoelectric refrigerators – Thermionic converters and other thermo– electric conversion systems. (9 hours)

UNIT – IV: THERMOELECTRIC AND MHD POWER GENERATION

Introduction. Thermoelectric effects. Thermodynamic analysis of Thermoelectric generator. Maximum thermal efficiency and maximum power output. Single stage and multistage generators. Thermoelectric materials. Applications. Gaseous conductors. Seeding. MHD equations. Operating range of an MHD duct. Different types of MHD generators. Thermodynamic analysis of linear constant velocity MHD generator. Electrical power output and efficiency. Adiabatic efficiency. Introduction to liquid MHD generator. (9 hours)

UNIT – V: FUEL CELL

Fuel cells and Batteries – Principles of EMF generation – Description of fuel cells – Applications of fuel cells – Direct electrolysis of water, thermal decomposition of water, biological and biochemical methods of hydrogen production. Description of batteries: Primary, Secondary, Reserve and advanced battery system – Types – Characteristics – applications. (9 hours)

Text Books:

1. S.W.Angrist, Direct Energy Conversion, Allyn and Bacon, Boston, 1982
2. W.Culp Archie, Principles of energy conversion, Tata McGraw Hill Publishing Co.Ltd., New Delhi-2000.
3. W. R. Corliss, Direct Energy Conversion, United States Atomic Energy Commission, 1964.
4. I.M. Blair and B.O. Jones, Aspects of Energy Conversion

Reference Books:

1. K.Messerle Hugo, Magneto hydrodynamic Electric Power Generator, John Wiley & Sons, 1995.
2. D.Lindon, Handbook of Batteries and Fuel Cells, McGraw Hill Book Co., 1984.
3. M.A.Greem, Solar Cells, Prentice Hall Inc, Englewood Cliffs, 1982.
4. Rakosh Das Begamudre, Energy Conversion System, New Age International (P) Ltd., New Delhi, 2000.

Web Reference:

1. http://nptel.iitm.ac.in/courses.php
2. http://ocw.mit.edu/courses/
3. http://en.wikipedia.org

MEE53 ENGINEERING TRIBOLOGY (4 0 0 4)

OBJECTIVES

- *To introduce to the basics of Tribology and its inter – disciplinary nature.*
- *To make aware of practical objectives of Tribology.*
- *To understand the Effect of Tribology in the Economy of Nation.*
- *To know the influence of lubricant and lubrication in the life of Tribo – System.*
- *To introduce to the basics of Hydrostatic, Hydrodynamic and Electro – Hydrodynamic Lubrication.*
- *To learn the different tools in measurement of surface parameters.*

UNIT – I

Introduction to Tribology – Objectives of Tribology - Surfaces - Nature of metal surfaces, surface properties, surface parameters and measurements – Fundamental of Contact between Solids –Surface Treatment – modification – coatings. (09 hours)

UNIT – II

Physical Properties of Lubricants – Viscosity measurements – Viscosity Shear Rate – Viscosity Pressure Relationships – Classification – Thermal- Optical Properties – Additives in Lubricants – and its composition – Lubricant Classification - Introduction to friction, friction measurement, theories of friction, adhesion and ploughing friction - Types of wear, wear mechanisms, factors affecting wear, material selection for different wear situations. (09 hours)

UNIT – III

Theory of hydrodynamic lubrication, Reynolds equation, assumptions and simplifications, variable density and compressibility, hydrodynamic journal bearings, pressure equation for short and finite bearings, journal bearing parameters, friction in journal bearings. (09 hours)

UNIT – IV

Introduction to Computation Hydrodynamics – Non - dimensionalization of Reynolds Equation - Hydrostatic Lubrication – Basics of Elasto-hydrodynamic Lubrication, boundry and extreme pressure lubrication (09 hours)

UNIT – V

Tribo Measurement and Instrumentation – Surface topography measurements – AFM and SFA – Friction and Wear Measurements – Bearing performance and Vibration Measurements (09 hours)

Text Books:

1. Gwidon W. Stachowiak Andrew W. Batchelor Engineering Tribology, Butterworth Heinemann, UK,2005
2. Prasanta Sahoo Engineering Tribology, Prentice-Hall of India Pvt Ltd, NewDelhi,2005

Reference Books:

1. Bharat Bhusan Modern Tribology Handbook , Vol-1 and 2, CRC Press, Washington D.C, 2001
2. F.P.Bowden and D.Tabor Friction and Lubrication, Heinemann Educational Books Ltd., 1974.
3. M.J.Neale, Hand Book of Tribology, Butter Worths, U.K.
4. D.D.Fuller, Theory and Practice of Lubrication for Engineers, John Wiley & Sons, New York.
5. K.C. Ludema – Friction, Wear, Lubrication, LRC Press, 1996.

MEE54 INDUSTRIAL CASTING TECHNOLOGY (4 0 0 4)

COURSE OBJECTIVES

To acquaint the student interested in the production of metal castings, with the essential techniques required for the production of castings in ferrous/non-ferrous metals and plastics, from basic pattern making to moulding and metal pouring. Also, to understand the factors affecting the casting process as a production method, and how to improve the products quality and reduce production cost.

COURSE OUTCOMES

Upon completion of the course, the students will have the ability to understand the importance of casting process in the overall manufacturing activity and will be in a position to select a suitable casting process for a given application.

SYLLABUS:

Unit I : Patterns and Moulding Sands: Introduction to casting - pattern making – requirements, pattern materials, machines and tools for pattern making – pattern allowances - metal and consumable type of patterns - life expectancy, storage and repair of patterns - moulding sands and sand conditioning – testing of moulding sands – cores – types of cores - core sands and core making - machine moulding. (9 hours)

Unit II : Melting equipment for foundries – crucible furnace – open hearth furnace – air furnace – rotary furnace – cupola furnace – electric furnaces – refractories for melting units - metallurgical characteristics of cast metals – Solidification of metals. (9 hours)

Unit III : Gating and Risering of castings – gating systems – different types of gates – calculation of gating system dimensions - risering of castings - open and blind risers - design and positioning of risers – directional solidification – methods to achieve directional solidification - form design of castings. (9 hours)

Unit IV : Moulding Processes : special sand moulding processes - Permanent mould casting – Pressure die casting – Low pressure die casting – Squeeze casting – Centrifugal casting – continuous casting – Electro slag casting – Vacuum moulding process - plastic moulding processes : compression moulding, transfer moulding, injection moulding, extrusion and blow moulding. (9 hours)

Unit V : Cleaning and inspection – Fettling and repair of castings - Heat treatment of castings, Defects in castings, Inspection and testing of castings – Pollution control in foundries – Plant layout for foundries – Areas of mechanization. (9 hours)

TEXT BOOKS :

1. P.L.Jain, Principles of Foundry Technology, Tata McGraw Hill, 5th Edition, 2009.
2. O.P.Khanna, Foundry Technology, Dhanpat Rai Publications, 2011
3. Serobe Kalpakjian and Steven R.Schmid, Manufacturing Engineering &Technology, Pearson Education Asia, 7th Edition, 2013 (For Plastic Moulding Processes only)

REFERENCE BOOKS :

1. Richard W.Heine et al. - Principles of Metal Casting, Tata McGraw Hill Edition, 2013.
2. T.V.Ramana Rao, Metal Casting: Principles and Practice, New Age International, 2010.

E LEARNING RESOURCES :

1. www.nptel.ac.in
2. Peter Beeley, Foundry Technology, Elsevier, Second Edition, 2001.
3. John Campbell, Complete Casting Handbook: Metal Casting Processes, Metallurgy, Techniques and Design, Elsevier, 1st Edition, 2011.

MEE55 NUCLEAR POWER ENGINEERING (4 0 0 4)

OBJECTIVES

- *To study Radioactivity concept with Mechanical Applications.*
- *To understand the concept of Nuclear reaction.*
- *To study the Neutron flux and Diffusion theory.*
- *To understand the principle of Thermal reactors.*
- *To understand the concept of Thermal design of reactor.*

UNIT – I

Radioactivity – nuclear reactions – binding energy – neutron interaction – cross sections – fission – power from fission – fission chain reactions – criticality – conversion and breeding – nuclear fuel performance. (9 hours)

UNIT – II

Nuclear power reactors – nuclear fuel cycles – fuel enrichment – fuel assembly – fuel reprocessing – decommissioning of power plants – radioactive waste disposal and its management. (9 hours)

UNIT – III

Neutron flux – diffusion theory applicaions – ficks law – solution to diffusion equation for point source – plannar source and bare slab – diffusion length – energy loss in scattering collisions – moderators. (9 hours)

UNIT – IV

One group reactor equation – one group criticality equation – thermal reactors – criticality calculations – homogeneous and heterogeneous reactors – reactor kinetics and safety – prompt neutron life time – reactor with and without delayed neutrons – prompt criticality – control rods– principles of nuclear reactor safety. (9 hours)

UNIT – V

Heat generation in reactors – thermal constraints – heat transfer to coolants – thermal design of reactor. (9 hours)

Reference books:

1. Lamarsh,J.R., Introducation to Nuclear Engineering, Addison-Wesley, New York,1983.
2. Marshall,W., Nuclear Power Technology -Vol.I,II&III,Clarendon Press, Oxford,1985.
3. SamuelGlasstone, Principle of Nuclear Reactor Engineering, Van NostrandReinhold Co.,NewYork,1963.
4. Culp,ArchieW., Principles of EnergyConversion,McGrawHillBookCo.,1991

Web reference:

en.wikipedia.org/wiki/**Nuclear_engineering**
web.mit.edu/nse/
www.iitk.ac.in/net
www.nuc.berkeley.edu/
www.engr.utk.edu/**nuclear**
www.ne.ncsu.edu
www.engr.wisc.edu/ep/ep-research-priorities-**nuclear**-**engineering**.html
www.sciencebuddies.org
www.ans.org/StudyGuide
nuclear.mst.edu/

www.bls.gov/ooh/architecture-and-**engineering**/**nuclear**-**engineers**.htm
www.journals.elsevier.com/**nuclear**-**engineering**-and-design/
www3.imperial.ac.uk/**nuclearengineering**/courses/msc
www.nuceng.ufl.edu/
www.ans.org/StudyGuide
www.**nptel**.ac.in/courses

ELECTIVE – II

MEE61 AUTOMOBILE ENGINEERING (4 0 0 4)

OBJECTIVES

- *To explain the construction features of chassis systems.*
- *To analyze the various layouts by applying principles of mobility mechanics.*
- *To analyze the different configurations of IC engines by the principles of engine kinematics.*
- *To explain the transmission system of automobile*
- *To explain the Electrical system of automobile*

UNIT I

Classification of vehicles – drives - general layout. Engine - Diesel and Petrol engines for automobiles - two stroke and four stroke engines - comparison of performance - factors affecting choice - power requirements of an automobile - rolling, wind and gradient resultant-factors affecting resistance and power requirement. (09 hours)

UNIT – II

Power transmission system - requirement of transmission system – clutches - plate clutches – semi automatic & automatic clutches - Gear box: manual shift four speed and positive speed gear boxes - synchromesh devices -fluid transmission - fluid flywheel and torque converter-automatic transmission - drive line - differential, conventional and non-slip types - drive axle. (09 hours)

UNIT – III

Suspension system – requirements - rigid axle and independent suspension - types of suspension - leaf spring - coil spring - torsion rod and air suspension - shock absorbers. Front axle : types – front wheel geometry - conditions for true rolling. Steering geometry - Ackerman and Davis steering - steering linkages - steering gear box-power and power assisted steering.
Wheel alignment - Tyres: materials and types static and rolling properties of pneumatic tyres. (09 hours)

UNIT – IV

Braking system - hydraulic braking systems - drum type and disc type brakes - power and power assisted brakes - factors affecting brake performance - tests on brakes - skid and skid prevention. Chassis - types of bodies - chassis frame - integral body - vehicle stability. (09 hours)

UNIT – V

Battery: types - Chemical reaction – charging - battery rating - battery life - battery testing. Starting motor: constructional features and operation - series wound motor - drive arrangements: types, Ignition: types - ignition coil - contact breaker – distributor - firing order - spark plug. Generator - constructional features of D.C.generator and Alternator – Rectifier - Generator regulation - Automotive lighting - Electronics in automobile. (09 hours)

Text Books:

1. W.H.Crouse, Automotive Mechanics, Tata McGraw Hill Publishing Co., 1995.
5. V.L.Maleev, Internal Combustion Engines, McGraw Hill, 1987.

Reference Books:

1. Newton Steeds & Garret, The Motor Vehicle.
2. Joseph Heitner, Automotive Mechanics, CBS Publishers & Distributors, 1987.
3. R.B. Gupta, Automobile Engineering, Satya Prakashan, New Delhi, 1997.
4. R.B. Gupta., Auto Design, Satya Prakashan, New Delhi, 1995.

MEE62 COMPUTATIONAL FLUID DYNAMICS (3 1 0 4)

OBJECTIVES

- *To study about the fundamentals of Fluid Flow.*
- *To know about various types of discretization.*
- *To study Finite difference methods (FDM), Finite element method (FEM), Finite volume method (FVM).*
- *To study the different types of grid generation.*
- *To study specialized techniques.*

UNIT – I INTRODUCTION

Basics of Computational Fluid Dynamics (CFD) – One dimensional computation: Finite difference methods (FDM) – Finite element method (FEM) – Finite volume method (FVM) – boundary conditions for FDM, FEM, and FVM. Governing equations: Classification of partial differential equations (PDE) – Navier-Stokes system of equations – boundary conditions. (09 hours)

UNIT – II FDM

Finite difference methods – Derivation of Finite Difference equation – Simple method – General method Higher order derivatives – Multi Dimensional Finite Difference Formulas – Mixes derivatives – Solution methods – Incompressible viscous flows - Artificial compressibility method – Pressure correction method. – Compressible viscous flows - Euler equations and Potential equations. (09 hours)

UNIT – III FEM

Finite element methods – Formulation – Finite element interpolation functions – Linear problems – Non-linear problems – Incompressible viscous flows – Compressible viscous flows – Finite volume methods through finite difference methods – Formulations of finite volume equations: Burgers' equations – Incompressible and compressible flows. (09 hours)

UNIT – IV GRID GENERATION

Structured grid generation: Algebraic methods – PDE mapping methods – Surface grid generation – Multiblock structured grid generation. Unstructured grid generation: Delaunay- Voronoi methods (DVM) – Advancing front methods (AFM) – Combined DVM and AFM – Three dimensional applications. Adaptive methods: Structured and unstructured adaptive methods. (09 hours)

UNIT – V SPECIALIZED TECHNIQUES

Computing techniques: Domain decomposition methods – Multigrain methods – Parallel processing. Applications of CFD: Turbulence – combustion – acoustics – Heat transfer – Multiphase flows – Electromagnetic flows. (09 hours)

Reference books:

1. Anderson,D.A.,Tannehill, J.C. andPletcher,R.H.,- Computational Fluid Mechanics andHeatTransfer, Hemisphere Publishing Corporation, NewYork, 2011
2. Wendt,J.F.(Ed.),Verlag-Computational Fluid Dynamics–AnIntroduction, Springer, 2012
3. Zienkiewicz,O.C.and &Morgan,K,-Finite Element and Approximation, John Wiley Sons,2000..
4. Reddy,J. N., - An Introduction to Finite Element Method, McGrawHill Book Co.,2005.
5. Gunzburger,M.D.,-Finite Element Method for Viscous Incompressible Flows, Academic PressInc.,NewYork,2005.

6. Chung,T.J., - Computational Fluid Dynamics, Cambridge University Press,2003
7. Hoffmann,K.A., -Computational Fluid Dynamics for Engineers, Engineering Education system,Wichita,Kansas,USA,1993
8. Muralidhar,K.and Sundararajan, T-Computational Fluid Flow and Heat Transfer, NarosaPublishingHouse,N.Delhi,2002
9. Fletcher,C.A., -Computational Techniques for Fluid dynamics, Vol.1: Fundamental and general techniques, Spring-Verlag, Berlin,2007
10. Fletcher,C.A.-Computational Techniques for Fluid dynamics, Vol.1: Specific techniques for different flow categories, Spring- Verlag,Berlin,2007

Web reference:

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https://twitter.com/**cfdonline**
www.**cfd**.com.au/
www.flow3d.com/home/resources/**cfd**
https://eurobank.**cfdonline**trader.com/
www.**cfd**-software.org/
www.**researchgate**.net/
nptel.ac.in/
nptel.iitk.ac.in/

MEE63 FINITE ELEMENT METHODS (3 1 0 4)

OBJECTIVES

- *Teach students about variational method and weighted residue method.*
- *Illustrate students about element shape functions and numerical integration.*
- *Teach about a one dimensional FEA for second order and fourth order ODE.*
- *Teach about a two dimensional structural FEA for second order ODE.*
- *Teach about a two dimensional steady state heat transfer FEA for second order ODE.*

UNIT – I

Basic Concept of FEM, discretisation, comparison with finite difference method, advantages and disadvantages, history of development, application. Variational and Weighted Residual Formation : Boundary value problems, approximated methods of solution, review of variational calculus, geometric and natural boundary condition, method of Weighted residuals, Rayleigh Ritz and Galerkin methods of finite element formulations and convergence criteria, weak formulation - simple problems.

(09 hours)

UNIT – II

Classification of C0, C1 continuous problems-Parameter functions, its properties-completeness and compatibility condition, One-dimensional elements, Global coordinates, Two-dimensional elements, three noded triangular elements and four noded quadrilateral elements. Natural co-ordinate systems –Lagrangian Interpolation Polynomials- Serendipity Formulation- Difference between Superparametric, Subparametric and Isoparametric Elements, Isoparamatric Elements Formulation, length coordinates– 1D bar elements, C0 continuous shape function, beam elements, C1 continuous shape function - 2D Triangular elements, Rectangular elements. – Area coordinates- Numerical integration – simple Problems using Gauss quadrature Technique. (09 hours)

UNIT – III

One dimensional second order equations, discretisation of domain into elements, derivation of element equations, assembly of element equation, imposition of boundary conditions, solution of equations - post processing, extension of fourth order equations and their solutions – examples from solid mechanics, heat transfer. (09 hours)

UNIT – IV

Basic Boundary Value Problems in 2 Dimensions – Introduction to Theory of Elasticity – Plane Stress – Plain Strain and Axisymmeteric Formulation – Principle of virtual work – Weak Formulation – triangular, Quadrilateral elements - Element matrices using energy approach. -Simple problems using three noded triangular elements only – Frontal Solution Method – Static condensation. (09 hours)

UNIT – V

Green-Gauss Theorem-Element equation formulation – Variational calculus approach- Galerkin approach – General Two-Dimensional Heat Conduction – Axisymmetric Heat conduction - Triangular, Quadrilateral elements - Simple problems using three noded triangular elements (generalized approaches only). Finite Element Analysis Software : Pre- and Post –Processors - General Requirements, Method of FE model generation- Graphical Output facilities – FEA software Packages, Recent trends – Error estimates and Adaptive Meshing. (09 hours)

Content beyond syllabus:

1. verifying the 1D, 2D thermal/structural problems using any FEA software package
2. Discussion about non-linear problems.

Text books:

1. Frank L.Stasa, Applied Finite Element Analysis for Engineers, CBS International, Edition, 1985.
2. J.N.Reddy, An Introduction to Finite Element Method, McGraw Hill International Edition, 2005.

Reference books:

1. Cook Robert Devis et al, Concepts and Application of finite Element Analysis, Wiley John & Sons, 2002.
2. S.S.Rao, Finite Element Method in Engineering, Butterworth-Heinemann, 2005.
3. G.Buchaman, Schaum's Outline of finite Element Analysis, McGraw Hill,1994

Web Reference:

1. http://nptel.iitm.ac.in/video.php?subjectId=112104115
2. http://solidmechanics.org/FEA.htm#Matlab

MET64 INDUSTRIAL AUTOMATION (4 0 0 4)

OBJECTIVES

- *To impart knowledge on various advanced manufacturing technology available to the students.*
- *To develop an attitude towards effective use of advanced unconventional manufacturing process to machine new materials.*
- *To make students to understand and appreciate the latest manufacturing process for micro, nano fabrication and devices.*

UNIT – I

Hard Automation – I: Introduction to Automation in Manufacturing – Types of Automation- Study of the principles of working of automates – Applications. (09 hours)

UNIT – II

Hard Automation – II: Automated flow lines – Types. Transfer machines – types, mechanisms, applications, Transfer, Handling, Location, Orientation and Parts Feeding devices – Types and principles of working only. Buffer storage.
NC machines – Introduction, Types, Economics, Advantages and Applications.
CNC, DNC (Direct and Distributed), and Adaptive Control. (09 hours)

UNIT – III

Turning and Machining Centers – Description and types of ATC, Applications.
NC Part Programming – Types – Introduction to programming languages, APT Programming. Examples on CNC Turning, Milling & Drilling operations. Preliminary study on simulation of CAD based NC programming. (09 hours)

UNIT – IV

Robot Anatomy and Configurations, Work Volume, End effectors – Types of grippers, tool as end effectors.
Robot Sensors – External and Internal, Types – Position sensors, Velocity sensors, Tactile, Proximity and Range sensors, Machine vision - Applications.
Automated Material Handling and Storage Systems – Types, Design and Interfacing Preliminaries. (09 hours)

UNIT – V

Group Technology: Part Families – Parts Classification and Coding, Examples. Applications.
Flexible Manufacturing Systems: Types, Components, Planning and Implementation Issues.
Introduction to Lean and Agile Manufacturing Systems – Comparison. (09 hours)

Text Books:

1. Mikel P.Groover, Automation, Production Systems and Computer Integrated Manufacturing, PHI Ltd., New Delhi, 2003.
2. P.Radhakrishnan,NC Machine Tools, Dhanpat Rai & Sons, New Delhi, 2000.
3. G.Boothroyd et al, Automatic Assembly, Marcel Dekker Inc., New York, 1993.

Reference Books:

2. P.N.Rao et al, Computer Aided Manufacturing, Tata McGraw Hill Publishers, 1993.

P.Radhakrishnan and S.Subramanian - CAD/CAM/CIM, Wiley Eastern Ltd., 2000.

MEE65 MECHATRONICS (4 0 0 4)

OBJECTIVES

- *To emphasize the importance of Mechatronics in Engineering Design, Measurements and Mechanical systems.*
- *To explain about Logic Circuits adopted in Flip Flops & Digital IC's.*
- *To Study about Microprocessors & A/D, D/A Convertors.*
- *To expose students to various basic and advanced Sensors, Actuators & PLC's with appropriate usage.*
- *To brief the principles of Control architecture.*

UNIT – I

Introduction to Mechatronics – Mechatronics in Products – Mechatronics in Engineering Design – Measurement Systems – Electronics for Mechanical – Mechanical System for Electronics. System Response – Dynamic Characteristics of Systems – zero order - First order – Second order – System Modeling and analogies. (09 hours)

UNIT – II

Amplifier – Operational amplifier – Instrumentation amplifier – comparator. Digital Representations – Boolean algebra – Design of logic Network – Flip flops – Application of flip flops – Special purpose Digital integrated circuits. (09 hours)

UNIT – III

Microprocessors and micro Computers – Micro Controllers – Numeric key board – LCD Display – Method to Design a Micro controller based system. Data acquisition – quantizing theory – Analog to Digital conversion – Digital to Analog conversion. (09 hours)

UNIT – IV

Performance Terminology – Semi conductor Sensors and micro electro mechanical Devices - Actuators – Hydraulics Actuators – pneumatic Actuators.
Programmable Logic Controllers (PLC) – basic structure – input / output processing – programming – Mnemonics Timers – relays and counters – data handling – selection of PLC. (09 hours)

UNIT – V

Control architecture – Analog – Digital – Micro Controller – Single Board Computer – personal Computer designing. Case studies of Mechatronic system. Introduction to design of Mechatronic systems - Coin counter - Robotics - Magnetic Bearings etc. (09 hours)

Text Books:

1. David G.Alciatore and Mecheal.B.Histand, Introduction of Mechatronics and Measurement Systems, McGraw Hill International Edition, 1999.
2. HMT, Mechatronics, Tata McGraw Hill Publishing Company Ltd., 1998.
3. Lawrence J.Kamm, Understanding Electro – Mechanical Engineering, An Introduction to Mechatronics, Prentice Hall, 2000.

MEE66 NANO TECHNOLOGY (4 0 0 4)

OBJECTIVES

- *To equip graduates with the broad range of the skills required to flourish in the rapidly developing field of nanotechnology.*
- *To study on various nano-materials, principal fabrication approaches and nano-scale characterization tools.*
- *To create a strong research focus among the undergraduate students to take up state-of-the-art research.*
- *To develop the student's ability to create and devise realistic industrial nano devices.*

UNIT – I

Elements of Nanoscience and Nanotechnology - Fundamentals and overview of nanoscience -Nanorevolution of the 20th century, Properties at nanoscale (optical, electronic and magnetic). Theory, definitions and scaling. (9 hours)

UNIT – II

Properties of Nanomaterials - Metal and Semiconductor Nanomaterials, Bucky balls and Carbon Nanotubes, Nano structures - Electronic Structure of Nanoparticles-Nanostructured Materials- Zero dimensional, one-dimensional and two dimensional nanostructures. (9 hours)

UNIT – III

Synthesis of Nanomaterials - Synthesis of bulk nano-structured materials –sol gel processing –Mechanical alloying and mechanical milling- Inert gas condensation technique, Nanolithography, CVD, chemical synthesis, Wet Deposition techniques, Self-assembly. (9 hours)

UNIT – IV

Characterization - Scanning Electron Microscopy (SEM), Scanning Probe Microscopy (SPM), TEM and EDAX analysis, X-ray diffraction, Fluorescence Microscopy and Imaging, STM - AFM and their application in nanotechnology. (9 hours)

UNIT – V

Applications of Nanotechnology - Nano Devices and Sensors-Nano fabrication and machining- Nanocoatings- Nanotechnology in Health Care, Solar cells - Thin film Si solar cells, Fuel Cells. (9 hours)

Reference books:

1. Guozhong Cao - Nanostructures and Nanomaterials , synthesis , properties and applications, Imperial College Press ,2004.
2. Pradeep, T - NANO:The Essential, Understanding Nanoscience and Nanotechnology, Tata McGraw-Hill Publishing Company Limited, 2007.
3. Charles Poole, P. Jr. - Introduction to Nanotechnology, John Willey & Sons, 2003.
4. Nabok, A. - Organic and Inorganic Nanostructures, Artech House, 2005
5. Dupas, C. Houdy, P. Lahmani, M - Nanoscience: Nanotechnologies and Nanophysics, Springer-Verlag Berlin Heidelberg.

MEE67 THEORY OF METAL CUTTING (4 0 0 4)

OBJECTIVES

To impart the knowledge and train the students in the area of metal cutting theory and its importance. To make the students familiar with the various principles of metal cutting, cutting tool materials and its wear mechanisms during the machining operation.

UNIT – I

Tool geometry – cutting tool geometry for turning, drilling and milling tools – tool signature – tool designation: ASM, DIN – their relationship. (9 hours)

UNIT - II

Mechanism of chip formation – continuous, discontinuous and built up edge chips – deformation of chips – single shear plane theory – chip formation in drilling and milling. Introduction to oblique and orthogonal cutting. Mechanics of metal cutting, force system, Merchant's Circle – velocity relationship, relationship between forces, cutting speed, feed and depth of cut – experimental determination of cutting forces – tool dynamometers. (9 hours)

UNIT – III

Thermodynamics of chip formation: Sources of Heat – Mathematical modeling of sources of heat in affecting the rise of temperature – The shear plane temperature – average chip-tool interface temperature – distribution of shear plane temperature – non-iterative method for determining chip-tool and tool-work interface temperature – experimental determination of chip-tool interface temperature – experimental observation of metal cutting temperature – hot machining – theoretical estimation of work-piece temperature (9 hours)

UNIT – IV

Machinability – mechanisms of tool wear – Taylor's tool life equation – tool failure criteria (direct and indirect) – effect of cutting variables on tool life, machinability index. (9 hours)

UNIT – V

Cutting fluids – types, different methods of application, economics of machining – basic concepts, tool materials (HSS, carbide and coated tools, CBN and ceramics) – Chatter in machining. (9 hours)

Note: Simple problems are recommended wherever applicable.

Text Books:

1. A.Bhattacharya, Metal Cutting – Theory and Practice, Central Book Publishers, 1989.
2. B.L.Juneja & G.S.Sekhon, Fundamentals of Metal Cutting and Machine Tools, New Age International (p) Ltd., 2005.

Reference Books:

1. G.Kuppusamy, Principle of Metal Cutting, University Press, 1996.
2. M.C.Shaw, Metal Cutting Principles, IBH Publishers, 2002.
3. G.Boothryd, Fundamentals of Metal Machining, Tata McGraw Hill, 1983.
4. www.gtuinfo.in/metalcutting.aspx
5. www.faadooengineers.com/metalculting.pdf

ELECTIVE – III

MEE71 ENERGY AND ENVIRONMENTAL ENGINEERING (4 0 0 4)

OBJECTIVES

- *To make the student understand and Learn the technical and management skills required to identify and manage opportunities in the energy sector in the sustainable global environment*
- *To the tools required to synthesise strategies/ solutions to environmental problems*
- *To Acquire the knowledge and skills for a technical and managerial career in energy and environmental management sectors*
- *To Develop a critical understanding of the complex environment and ability to integrate various multi-disciplinary components to reach conclusions in holistic problems of sustainable energy generation and utilisation.*

UNIT – I

Energy conversion – global energy scenario – Indian context of energy – environmental aspects of fossil, nuclear, hydro and biomass energy conversion – gaseous emissions – solid waste – liquid waste. (9 hours)

UNIT – II

Energy management – need for energy conservation – energy auditing – role of energy manager – energy audit instruments – first and second law approach towards energy conservation. (9 hours)

UNIT – III

Energy conservation in boilers – procedure for efficiency calculation – energy conservation in industries: pumps, fans, compressed air systems, refrigeration and air conditioning system, DG sets, electrical motors, variable speed motors. (9 hours)

UNIT – IV

Pollutants – types – physical and chemical properties of air pollutants – behavior and fate of air pollutants – air pollutants and global climate – air pollutant effects. Pollution control laws and regulation – national and international – role of environmental monitoring in environmental management systems – continuous emissions monitoring systems. (9 hours)

UNIT – V

Pollution control – review of pollution control methods in thermal power plants – industrial – nuclear – automobiles – disposal/treatment of solid and liquid wastes – alternate fuels. (9 hours)

Text Books:

1. A.W. Culp, Principles of Energy Conversion, McGraw Hill Book Co., 1991.
2. Noel de Nevers, Air Pollution control Engineering, McGraw Hill Book Co., 2000.

Reference Books:

1. C.S. Rao, Environmental Pollution Control Engineering, New Age International Pvt. Ltd., 1995.
2. P.O. Callaghan, Energy Management, McGraw Hill Book Co., 1993.

MEE72 INDUSTRIAL ROBOTICS (4 0 0 4)

OBJECTIVES

- *To impart students a broad understanding of modern industrial automation technology.*
- *To develop skills in designing, building, programming and maintaining industrial automated systems*
- *To enable the student to understand the modern mechatronics components*
- *To develop the student's ability to evaluate appropriate technology and create and devise realistic industrial systems.*

UNIT - I

Robotics and Automation - Robot Definition, Classification of Robots, Robot System components, Functions of Robot System, Specification of Robot System, Robot Drives and Power transmission systems, Remote Centered Compliance devices. (9 hours)

UNIT - II

Robotic Sensory Devices, Non optical Position sensors, Optical position sensors, Velocity sensors, Accelerometers, Proximity sensors, Touch and Slip Sensors, Force and Torque sensors – Robot vision system. (9 hours)

UNIT - III

Methods of Robot programming – Lead through programming methods – capabilities and limitations, Textual Robot languages – Robot language structure – motion commands, end effectors and sensor commands, Robot programming functions, robot programming environment, On-Line and Off Line programming Languages. (9 hours)

UNIT - IV

Robot cell layouts – multiple Robots and machine interface, consideration in work cell design, interlocks, error detection and recovery, Robot cycle time analysis, simulation of Robot work cells. (9 hours)

UNIT - V

Applications of robots in material transfer, machine loading and unloading, welding, assembly and inspection, safety, training, maintenance and quality aspects, Economics and social aspects of robotics . (9 hours)

Text Books

1. K.S. Fu., R.C.Gonalez, C.S.G.Lee, " Robotics Control sensing ", Vision and Intelligence, McGraw Hill International Edition, 1987.
2. P.A. Janaki Raman, Robotics and Image Processing an Introduction, Tata McGraw Hill Publishing company Ltd.,1995
3. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education., 2009
4. Robot manipulators: mathematics, Programming and Control - Paul r p

References:

1. Mikell P. Groover, mitchell Weiss, " Industrial robotics, technology, Programming and Applications ", McGraw Hill International Editions, 1986.
2. Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, " Robotic engineering - An Integrated Approach ", Prentice Hall Inc, Englewoods Cliffs, NJ, USA, 1989.

Web reference

1. http://www.mecheng.iisc.ernet.in/~asitava/contents.pdf
2. http://www.mecheng.iisc.ernet.in/~asitava/pub11.html
3. http://www.ai.mit.edu
4. http://robotics.stanford.edu
5. http://www.cs.cmu.edu/~chuck/robotpg/robofaq/TOC.html
1. http://nptel.ac.in/courses/112101099/

MEE73 INTEGRATED MATERIALS MANAGEMENT (4 0 0 4)

OBJECTIVES

- *To provide the necessary knowledge, skills and foundations for acquiring a wide range of rewarding careers into the rapidly expanding world of Integrated Materials Management.*
- *To understand the advanced processing techniques*

UNIT – I

Importance of materials management – need for integrated concept – advantages – organization and control – materials research - materials planning and budgeting. Quality specification – source selection - creative purchasing - purchase systems – price forecasting and price calculation – negotiation –delivery conditions. (09 hours)

UNIT – II

Timing of purchases – Make or Buy - Buying seasonal commodities – purchasing under uncertainty – purchasing of capital equipment – international purchasing – import substitution –public buying – legal aspects - contracts – vendor rating – buyer-seller relationship and ethics. (09 hours)

UNIT – III

Stores Management – stores systems and procedures – incoming materials control – stores accounting and stock verification – obsolete, surplus and scrap management – codification and standardization - value analysis – material handling – storing and material handling equipments.
Inventory Management – various costs – lead time, safety stock and reorder point – Basic EOQ model – quantity discounts - P & Q systems of inventory replenishment - ABC analysis – simple problems on inventory and ABC analysis - Materials Requirement Planning (MRP). (09 hours)

UNIT – IV

Concepts of Physical distribution – need, importance and management – Warehouses – location and layout types - receiving and shipping procedures - Application of OR techniques (Transportation problems only). Common carriers – Insurance coverage – Transportation documents – railway / lorry receipts – Bill of lading – clearing, forwarding and demurrage - evaluation of materials management performance – computers in materials management. (09 hours)

UNIT – V

Creating the logistics vision – problems with conventional organizations – developing logistics organizations - need for integration – managing supply chain as a network – process integration and ECR – comakership and logistics partnerships – supplier development.
New organizational paradigm – managing supply chain of the future – role of information in the virtual supply chain – route map to integrated supply chain.
(09 hours)

Text Books:

1. P.Gopalakrishnan and M.Sundaresan, Materials Management – An integrated approach,Prentice Hall of India Pvt. Ltd., 2000.
2. Donald M Dobler et al., Purchasing and Materials Management – Texts and Cases, Tata McGraw Hill Publishing Co. Ltd., 1985.
3. Martin Christopher, Logistics and Supply Chain Management, Pitman Publishing, 2000.
   (For Unit V Logistics and Supply Chain Management)

Reference Books:

1. J.R.Tony Arnold et al, Introduction to Materials Management, IV Edition, Pearson Education Asia Ltd., 2001.
2. A.K.Dutta, Materials Management – Procedures, Text and Cases, II Edition, Prentice Hall of India Pvt. Ltd., 2001

MEE74 METAL FORMING PROCESSES (4 0 0 4)

OBJECTIVES

- *To impart knowledge on plasticity, surface treatment for forming of various types of metal forming process.*
- *To understand the basic concepts of metal forming techniques and to develop force calculation in metal forming process.*

UNIT – I

Classification of forming processes – flow curves and their significance in forming – Effect of temperature, speed and metallurgical structure on forming processes – Effect of friction on forming processes. Basic concepts of yield criteria – types. (9 hours)

UNIT – II

Classifications of forging processes - Forging equipment – forging die design procedure for simple products – forging defects – determination of forging load – concept of P/M forging – Applications. (9 hours)

UNIT – III

Rolling mills – Estimation of rolling load and power – rolling defects – Applications. Direct extrusion equipment - hydrostatic extrusion - extrusion of tubes – determination of extrusion stress - extrusion defects – Applications. (9 hours)

UNIT – IV

Drawing of rods, wires and tubes-Determination of drawing loads through conical dies, sheet metal forming: Shearing, blanking, bending, punching, piercing, stretch forming, deep drawing, rubber pad forming –Applications. (9 hours)

UNIT – V

High rate energy forming processes: Introduction - Effect on mechanical properties and microstructures – Explosive forming, Electro hydraulic forming – Electromagnetic forming, Water hammer forming. (9 hours)

Note: Elementary treatment with simple problems only.

Text Books:

1. Dieter, Mechanical Metallurgy, McGraw-Publishing Co., New York, 2002.
2. P.C.Sharma, Production Engineering, S.Chand & Co., New Delhi, 2008.
3. Serope Kalpakjian, Steven R Schmid, “Manufacturing Process for Engineering Materials” Pearson Education, 4th Edition, 2003.

Reference Books:

1. G.W.Rowe, An Introduction to the Principles of Metal Working”, Edward, Arnold Publications, 1973.
2. Gyril Donaldson, Tool Design, Tata McGraw Hill Publishing Co. Ltd., 1989.
3. Altan T., Metal forming – Fundamentals and applications – American Society of Metals, Metals park, 2003.

E-learning source:

1. **www.nptel.ac.in**
2. **www.sciencedirect.com**

MEE75 PRODUCT DESIGN AND DEVELOPMENT (4 0 0 4)

OBJECTIVES

- *To teach students how to apply the concepts of stress analysis, theories of failure and material science to analyze, design and/or select commonly used machine components.*
- *To illustrate to students the variety of mechanical components available and emphasize the need to continue learning.*
- *To teach students how to apply mechanical engineering design theory to identify and quantify machine elements in the design of commonly used mechanical systems.*
- *To teach students how to apply computer based techniques in the analysis, design and/or selection of machine components.*

UNIT – I

Definition – Design by Evolution and by Innovation - factors to be considered for product design – Production-Consumption cycle – The morphology of design – Primary design Phases and flow-charting. Role of Allowance, Process Capability, and Tolerance in Detailed Design and Assembly Product strategies, Market research – identifying customer needs – Analysis of product – locating ideas for new products, Selecting the right product, creative thinking, curiosity, imagination and brain storming - product specification. (9 hours)

UNIT – II

Task - Structured approaches – clarification – search – external and internal – systematic exploration – conception, selection - methodology benefits.
The value of appearance - principles and laws of appearance – incorporating quality, safety, and reliability into design. Man-machine considerations – Designing for ease of maintenance. (9 hours)

UNIT – III

Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing process – Needs for industrial design-impact – Industrial design process – Technology driven products - user driven products – assessing the quality of the product. (9 hours)

UNIT – IV

Methodologies and tools - Design axioms - Design for assembly and evaluation - Minimum part assessment - Taguchi Method - Robustness assessment - Manufacturing process rules - Designer's tool kit - Computer aided group process rules - Designer's tool kit - Computer aided group technology - Failure Mode Effective Analysis – Design for minimum number of parts – Development of modular design – Minimizing part variations – Design of parts to be multi-functional, multi-use, ease of fabrication – Poka Yoka principles. (9 hours)

UNIT – V

Estimation of manufacturing cost – cost procedures – Value Engineering - reducing the component cost and assembly cost – minimizing the system complexity – Basics and Principals of prototyping – Economic Analysis: Break even analysis. Classes of exclusive rights – Patents – Combination versus aggregation – Novelty and Utility – Design patents – Paten disclosure – Patent application steps - Patent Office prosecution - Sales of patent rights - Trademarks – copy rights. (9 hours)

Text Books:

1. Karl.T.Ulrich, Steven D.Eppinger, Product Design and Development, McGraw Hill International 4th Edition, 2008.
2. Benjamin W.Niebel and Alanb. Draper Product Design and Process Engineering, McGraw Hill Book Co., 1985.
3. A.K.Chitale and R.C.Gupta, Product Design and Manufacturing, Prentice Hall of India Private Limited, New Delhi, 2002.

Web Reference:

1. www.nptel.iitm.ac.in

MEE76 SOLAR POWER ENGINEERING (3 1 0 4)

OBJECTIVES

- *To introduce and develop the techniques that constitutes the basis of solar energy harvesting and storing of clean energy.*
- *To cover the elements of fluid mechanics and heat transfer in solar systems.*
- *To cover a range of modern approaches for thermodynamic and numerical analysis, without entering all these topics in detail, but aiming to provide students with a general knowledge and understanding of the subject, including recommendations for further studies.*

UNIT – I

Solar radiation - radiation at the earth's surface – measurement of solar radiation - solar radiation data geometry – solar radiation on tilted surfaces – relationship among absorption and emittance and reflectance – Selective surfaces. (9 hours)

UNIT – II

Flat plate collectors – transmissivity of cover system – collector efficiency – liquid plate collector – performance of flat Plate collector. Concentrating collectors – flat plate collector with plane reflector – cylindrical parabolic collector – compound parabolic collector – central receiver collector. (9 hours)

UNIT – III

Solar heating – air heating system – solar energy heat pump system – solar water heating system: forced and natural circulation system – passive solar heating system – green house effect.
Solar cooling – absorption cooling – vapour absorption refrigeration – solar desiccant Cooling-Solar drier and dehumidifier – solar pond – domestic, commercial and industrial applications of solar heating / cooling systems. (9 hours)

UNIT – IV

Photovoltaic Principle –materials for photovoltaic cells – design and fabrication of photovoltaic cells – performance analysis of photovoltaic cells – Thermoelectric generator solar cell – photochemical solar cells – solar cells in terrestrial and space applications. (9 hours)

UNIT – V

Solar power systems – electrical power generation – solar thermal power plants – low, medium and high temperature power generation systems: using flat plate collectors or solar ponds, concentrating collectors, central receiver and solar chimneys – solar energy process economics. (9 hours)

Text Books:

1. S.P.Sukhatme, Solar Energy – Principles of Thermal Collection and storage, 3rd edition,Tata McGraw Hill Publishing Co., New Delhi, 2013.
2. J.A.Duffie & W.Beckmann, Solar Thermal Processes, John Wiley, 4th edition, John Wiley, 2013..
3. D. Yogi Goswami, Frank Kreith and Jan F. Kreider, Principles of Solar Engineering, Taylor and Francis, 2003.

Reference Books:

1. N.K.Bansal et al, Renewable Energy Sources and Conversion Technology, Tata McGraw Hill Publishing Co., New Delhi, 1990.
2. Jiu Sheng Hsieh, Solar Energy Engineering, Prentice Hall, 1991.

3. Edward E. Andreson, Fundamentals of solar energy conversion, Addison-Wesley Publishing Company, 2002.

Web Reference:

1. http://nptel.iitm.ac.in/courses.php
2. http://ocw.mit.edu/courses/
3. http://en.wikipedia.org

ELECTIVE – IV & V

MEE81 ADVANCED WELDING TECHNIQUES (4 0 0 4)

OBJECTIVES

- *To impart knowledge on basic concepts and process mechanisms of welding Processes.*
- *To understand the metallurgical concepts and applications welding process.*

UNIT – I

Introduction to different types of welding – Welding Symbols – Weld Joint selection – Preparation of weld Joints – Welding Metallurgy – Structure of Welded metals.
Gas Welding : Theory of ionization of Gas Welding Systems – Ferrous and Non – Ferrous Welding, Gas Cutting – Safety Precautions – Applications. (09 hours)

UNIT – II

Arc Welding : Introduction – Electrodes , Transfer of Metal from electrode- Power Supplies , Operation - Carbon Arc Welding, Metal Arc Welding, Gas Shield Arc Welding and Submerged Arc Welding Process – Arc Cutting Process – Applications. (09 hours)

UNIT – III

Plasma Arc welding – Electrogas and Electroslag Welding – Solid State Bonding.Electron Beam Welding – Laser Welding – Thermit Welding – Metal Flame Spraying. Introduction to Under water Welding - Applications. (09 hours)

UNIT – IV

Resistance Welding : Types , Process, Applications.
Welding of Plastics: Ultrasonic – Friction – Hot plate – Hot gas – High Frequency Welding of Plastics, Welding of plastic Pipes and other Applications. (09 hours)

UNIT – V

Testing of Welds: Introduction to Testing and Inspection of Welds – Destructive and Non Destructive Tests – Advantages and Limitations. Distortion in welds – Prevention. (09 hours)

Text Books:

1. Little, Principles of Welding Technology, Tata McGraw Hill, 1985.
2. Parmer R.S., Welding Engineering and Technology, Khanna Publishers,2002

Reference Books:

1. P.T.Hould Croft, Welding Process Technology, Cambridge University Press, 1983.
2. L.Carl Love, Welding Procedures and Applications, Prentice Hall Inc., 1993.
3. M.N.Watson, Joining Plastics in Production, Welding Institute, Cambridge, 1990.
4. ASM Handbook vol.6, welding Brazing & Soldering, 2003

MEE82 AUTOMOTIVE FUELS, POLLUTION AND CONTROL (4 0 0 4)

OBJECTIVES

To impart knowledge on

- *Fuel properties and testing of fuels*
- *theory of formation of different pollutant emissions and their control in SI engine and CI engines*
- *emission standards and emission instrumentation*
- *recent developments in IC engines for emission control e.g multi point fuel injection, CRDI etc*
- *the role of alternative fuels in emission control*

UNIT - I

Liquid fuels : gasoline and diesel –thermochemistry- properties-testing of fuels-` specific gravity, calorific value, boiling range, flash point, ignition temperature, viscosity, pour point, flammability limits, Fuel rating – octane rating and cetane rating - Fuel additives-requirements of additives, petrol and diesel fuel additives-fuel specification. Different pollutants from IC engines-their effect on human health and environment. (09 hours)

UNIT – II

SI engine pollutants-mechanism of pollutant formation-effect of mixture strength-hydrocarbon emission-wall quench theory-carbon-monoxoide and nitrogen oxides-emission control systems-fuel modification-EGR-crank case and evaporative emission control- Thermal and catalytic reactors, oxidation, reduction and 3-way catalytic reactors, closed loop feedback control-catalysts and substrates--recent developments in SI engines for emission control-lean burn engine-stratified charge engine-multipoint fuel injection. (09 hours)

UNIT – III

CI engine pollutants- Formation of hydrocarbons, oxides of nitrogen and particulate matter-smoke and its types-factors affecting smoke formation-SOF-diesel pollutants control-EGR-effect of engine variables-injection pressure-injection timing-recent developments in CI engines-low heat rejection engine-dual fuel engine-common rail diesel injection system-ultra high pressure diesel injection--Lean de-NOx catalysts-SCR- diesel particulate filters (DPF)- DPF regeneration (09 hours)

UNIT – IV

Chassis Dynamometer- Trends in vehicle emission standards, emission limits, test procedures, driving cycles. Measurement of emissions, instrumentation for CO HC, NOx, PM-Chemi-luminescence and NDIR Analyzers – Flame ionization detector – smoke measurement: Bosch smoke meter-Hatridge smoke meter -measurement of particulate matter-HCCI engines (09 hours)

UNIT – V

Alternative fuels for automobiles- biodiesel and ethanol, gashol-. Gaseous fuels: LPG, natural gas-biogas-methane and producer gas – physical and chemical properties-alternative fuels to reduce emissions: alcohols, natural gas, biodiesel, hydrogen, DME- bio- fuel additives for emission control. (09 hours)

Text Books:

1. John B.Heywood, Internal Combustion Engine Fundamentals, McGraw Hill (India) Pvt ltd, 1st Edition, 2011.
2. V.Ganesan, Internal Combustion Engines, Tata McGraw Hill, New Delhi, 4th Edition, 2012.
3. M. L. Mathur and R. P. Sharma, Internal Combustion Engines, Dhanpat Rai Publications, 2010

Reference Books:,

1. K.K.Ramalingam, Internal combustion engines , Scitech Publishers,2005
2. Renewable Automotive Fuels, Elsevier Science & Technology, 2014
3. S.S.Thipse, Alternative Fuels, 1st Edition, Jaico Publishing House, 2010

Web references:

http://www.en.wikipedia.org/wiki/**Emission**_standard
https://www.dieselnet.com/tech/measure.php
http://www.horiba.com/in/automotive-test-systems/products/ emission - measurement -systems/

MEE83 COMPOSITE MATERIALS (4 0 0 4)

OBJECTIVES

- *To learn the fundamental knowledge on composites materials and their unique properties.*
- *To be able to fabricate fiber reinforced, polymer composite products using a variety of processes and to know how variables affect the processing and product performance.*
- *To be able to use rework and repair methods common to the fabrication of composite products.*
- *To be able to synthesis a new advanced composite indigenously by individual student.*
- *To acquire knowledge on latest green composites.*

UNIT - I

Definition – Need – General Characteristics , Matrices – Polymer, Metal, Carbon and Ceramic Matrices, Reinforcement – Types – fibers, whiskers and particles, Reinforcement materials, Selection, advantages and limitations. (9 hours)

UNIT - II

Polymer Matrix Composites – Matrix Resins – Thermosetting resins, Thermoplastic resins, Polyacryl ethers (PAE), Thermoplastic Polyimides (TPI), Polyacrylene Sulfide, Molecularly ordered liquid Crystals (MOLC), Polyblends Alloys, Fibers and Laminar Composites. (9 hours)

UNIT - III

Metal Matrix Composites – Matrix selection, Reinforcement and reinforcement selection, Matrix reinforcement interface, Interaction zone, Interface bond strength. (9 hours)

UNIT - IV

Polymer Matrix Production Methods – Bag Moulding, Compression Moulding, Pultrusion, Filament Winding, Metal Matrix Composites - Fabrication methods – Solid State Techniques and Liquid State Techniques (9 hours)

UNIT - V

Micro mechanics and macro mechanics of composites, monotonic strength and fracture, Fatigue and Creep, Applications of composites, Green composites and Nano composites. (9 hours)

Reference books:

1. Krishan Chawla, K. - Composite Materials: Science and Engineering, Springer, 2001.
2. F.L.Mathews and Rawlings, R.D. - Composite Materials - Engineering and Science, CRC Press, 2002.
3. Sanjay K.Mazumdar - Composites Manufacturing: Materials, Product and Process Engineering, CRC Press, 2002.

E-learning source:

1. **www.nptel.ac.in**
2. **www.sciencedirect.com**

MEE84 FLUID POWER AUTOMATION (4 0 0 4)

OBJECTIVES

- *To make the students to learn the basic concepts of hydraulics and pneumatics*
  and their controlling elements in the area of manufacturing process
- *To train the students in designing the hydraulic and pneumatic circuits using ladder diagram.*
- *To impart knowledge in the area of hydraulics, pneumatic and fluid power components and its functions.*

UNIT – I

Introduction to fluid Power- significant Properties – Advantages – Filters – Seals – Hydraulic Pumps – Classification – Selection factors – Hydraulic Actuators – Linear – Rotary fluid Motors. (09 hours)

UNIT – II

Pressure – Direction – Flow Control valves, relief valves, non return and safety valves –
Accumulators – Linear Circuits – Regenerative Circuits – Intensifier Circuits – Metering –in-out Circuits. (09 hours)

UNIT – III

Types of pressure pumps- Reciprocation operation of multi cylinder – Quick return – sequencing – Accumulator Circuits – Use of pressure switches & limit switches – Hydrostatic transmission Circuits – Fluid Power maintenance and safety. (09 hours)

UNIT – IV

Basic Principles of Pneumatics – Types of Compressors – Elements of Pneumatic Systems – Filter, Lubricator, Muffler – Types of Directional control valve – air motors – air Cylinders. (09 hours)

UNIT – V

Basic Pneumatic Circuits – Speed Control – Sequencing of Motion – Hydro Pneumatic Circuits – Cascade Methods – Automation and Principle of Circuit design – Pneumatic Control applications In Machine Tool and other Mechanical fields – Maintenance. (09 hours)

Text Books:

1. Anthony Esposeto - Fluid Power with application, IV Edition, Prentice Hall, 1980.
2. S.R.Majumdar - Pneumatic Systems - Principles and Maintenance, Tata McGrawHill Publishing Company Ltd., 1995.

Reference Books:

1. Dudley A.Pease and - Basic Fluid Power, II Edition, Prentice Hall, 1998.
2. John J.Pippinger and Andrew Parr - Hydraulic and Pneumatics, Jaico Publishing House, 1999.
3. W.Bolton, Mechatronics, Electronic control systems in Mechanical and Electrical
   Engineering Pearson Education, 2003.

MEE85 MAINTENANCE AND SAFETY ENGINEERING (4 0 0 4)

OBJECTIVES

- *Focused study on the issues of maintenance, reliability and safety of technical systems*
- *Fault finding and diagnostics in engineering industry*
- *Knowledge of lubricants and lubrication systems*
- *Understand maintenance requirements of plant and equipment with increased sophistication and complexity.*
- *Hazard identification and risk assessment in operation and maintenance of industrial plant*
- *Familiarization with prevailing regulations for safe environment and health*

UNIT – I

Objectives of maintenance - types of maintenance – Breakdown, preventive and predictive maintenance - Repair cycle - Repair Complexity, Lubrication system – Lubricants - inspection. Maintenance of Mechanical transmission systems - align machinery – static and dynamic balancing - process plants – air conditioning – water purification – environmental control. (9 hours)

UNIT – II

Predictive Maintenance - vibration analysis data and noise as maintenance tool – wear debris analysis - Condition monitoring concepts applied to industries – diagnose faults – overhaul – testing and measurement using approved procedures - Total Productive Maintenance (TPM) - Economics of Maintenance- Computer aided maintenance – modern practice – modern manufacturing aspects. (9 hours)

UNIT – III

Reliability: Definition, concept of reliability based design, failure rate, MTTF, MTBF, failure pattern, system reliability: Series, Parallel and Mixed configurations - Availability and Maintainability concepts- Applications – electro, proportional and servohydraulic components – shutdown machinery – isolation – dismantle – inspect – NDT - assembly – fans – pumps – valves – bearings – static – dynamic seals. (9 hours)

UNIT – IV

Safety and productivity - causes of accidents in industries – accident reporting and investigation - measuring safety performance - Safety organizations and functions - Factories act and rules - Manufacture, Storage and Import of Hazardous Chemical rules - Explosive act - Gas cylinder rules – Electricity act. (9 hours)

UNIT – V

Safety Codes and Standards – Air Quality – indoor - outdoor – safe drinking water - General Safety considerations in Material Handling equipments - Machine Shop machineries-pressure vessels and pressurized pipelines – IBR - welding equipments – operation and inspection of extinguishers – prevention and spread of fire – emergency exit facilities - NFPA Standards – ISO 14000. (9 hours)

Text Books:

1. P.Gopalakrishnan and A. K. Banerji - Maintenance and Spare Parts Management, PHI Learning Pvt. Ltd., New Delhi, 2013.
2. Patrick D. T. O'Connor – Practical Reliability Engineering, Wiley, 2008.
3. B. S. Dhillon – Engineering Safety – Fundamental Techniques and Applications, World Scientific, 2003.

Reference Books:

1. R.C.Mishra and K.Pathak, Maintenance Engineering and Management, PHI Learning Pvt. Ltd., New Delhi, 2012.
2. H.P.Garg, Industrial Maintenance, S.Chand & Co Ltd., New Delhi, 1990.
3. Birolini, Reliability Engineering, Springer, 2014.
4. Rolland P.Blake - Industrial Safety, Prentice Hall of India Pvt. Ltd., New Delhi, 1973.

Web Resources:

1. https://www.coursera.org/course/
2. http://nptel.ac.in/courses/112106177
3. http://ocw.mit.edu/courses/nuclear-engineering/22-091-nuclear-reactor-safety-spring-2008/

MEE86 MEMS AND MICRO-NANO FLUIDICS (3 1 0 4)

OBJECTIVES

- Understanding of principles and processes involved in MEMS devices
- New application areas in diverse fields of engineering and scientific research
- Develop a deeper understanding of the fundamentals of physical phenomena involved at micro/nano scales
- Thermo-fluid flow analysis at micro/nano scales
- Novel methods of device construction, materials and their characterization
- Specification of miniaturized process design and interdisciplinary domain know how

UNIT - I

Introduction, Lab on a Chip, MEMS Technology, Physics - scaling issues in heat transfer and fluids, Derivation of governing equations of mass, momentum and energy, Fluid flow properties, Applications - Sensors, Microarrays, Microreactors, Microanalytical Chips – device fabrication – characterization – optical visualization (09 hours)

UNIT - II

Gas flows - Elements of kinetic theory of gases, Transition and Free Molecular Flow Regime, Rarefied gas phenomena, Gas surface interactions - Tangential momentum accommodation coefficient, Burnett equations, solution in microchannel. (09 hours)

UNIT - III

Liquid flows - Introduction, Challenges in mixing at microscales, Electrokinetic effects Analysis – EDL/Bulk flow interface velocity, governing equations of EOF – Complex geometry flows, Dielectrophoresis (09 hours)

UNIT - IV

Two-phase flows – Capillary effects, Surface Tension, Contact Angle, Marangoni effect, surface tension gradient, Gas bubbles, Two Phase Poiseuille Flow, Droplet and Digital Microfluidics – Hagen Poiseuille and Young Laplace pressure drops. (09 hours)

UNIT - V

Heat Transfer - Forced convection with slip, Thermal effects at microscales, Nanofluidics and Molecular dynamics – MD Continuum coupling, Direct simulation Monte-Carlo, Limitations and Errors in DSMC, Boltzmann Equation -Lattice Boltzmann method, Meshless Numerical Method. (09 hours)

Text Books:

1. Korvink, J. G., and Paul, O., MEMS - A practical guide to design, analysis and applications, Springer, New York, 2006.
2. Karniadakis, G., Beskok, A., and Aluru, N., Microflows and Nanoflows – Fundamentals and Simulation, Springer, New York, 2005.

Reference Books:

1. Rogers, B., Pennathur, S., and Adams, J., Nanotechnology – Understanding Small Systems, CRC Press, New York, 2008.
2. Probstein, R. F., Physicochemical Hydrodynamics – An Introduction, Wiley, New York, 1994.
3. Abgrall, P., Nguyen, N. T., Nanofluidics, Artech House, Boston, 2009.

4. Nguyen, N. T., and Wereley, S. T., Fundamentals and Applications of Microfluidics, Artech House, Boston, 2006.
5. Gomez, F. A. (Ed.), Biological Applications of Microfluidics, Wiley, New Jersey, 2008.
6. Bruus, H., Theoretical Microfluidics, Oxford University Press, New York, 2008.

Web Resources:

1. https://www.coursera.org/course/nanotech
2. http://nptel.ac.in/courses/112106169
3. http://ocw.mit.edu/courses/mechanical-engineering/2-76-multi-scale-system-design-fall-2004/

MEE87 PROJECT MANAGEMENT (4 0 0 4)

COURSE OBJECTIVES

This course addresses the basic nature of managing general projects, not specially focuses on one type of project, no matter construction projects or R&D projects. The course uses the project life cycle as the organizational guideline, and contents will cover the whole process of project management, including project initiation, project planning, project implementation and project control & review.

COURSE OUTCOMES

Upon completion of the course, the students will

1. Identify key components of a project
2. Describe the stages of a project and how each stage can be effectively managed.
3. Outline some of the tools and techniques that can be helpful when planning a project.
4. Explain the concept of risk management, as relevant to projects, and describe some techniques for identifying and managing risks.
5. Explain the importance of evaluating the effectiveness of a project and describe ways of doing this.

SYLLABUS:

Unit I : Indian project management scenario, Projects - Project ideas and preliminary screening. Developments - Project planning to Project completion - Pre-investment phase, Investment phase, operational phase - Governmental Regulatory framework. Capital Budgeting : Capital cost-time-value (CTV) system, managing project resources flow. (9 hours)

Unit II : Stages - Opportunity studies - General opportunity studies, specific opportunity studies, pre-feasibility studies, functional studies or support studies, feasibility study expansion projects, data for feasibility study.
Market and Technical Appraisal : Market and Demand analysis, Market Survey, Demand forecasting. Technical analysis- Materials and inputs, Choice of Technology, Product mix, Plant location, capacity, Machinery and equipment.
(9 hours)

Unit III : Appraisal process, Concepts and Techniques, Cost and Benefit from Financial angle - Basic principles for measuring costs and benefits, components of cash flow. Time value of money - Present and future value. Appraisal criteria - Urgency, Payback period, Rate of return, Debt service coverage ratio, Net present value, Benefit cost ratio, Internal rate of return, Annual capital charge, Investment appraisal in practice. (9 hours)

Unit IV : Cost of capital - Cost of different sources of finance, Cost of debt, preference capital, and Equity capital, Weighted average Cost of capital, Marginal cost of capital. Risk analysis- Measures of risk, Sensitivity analysis, and Decision tree analysis. Social cost benefits analysis (SCBA) - Rationale for SCBA, UNIDO approach.
Cost of Capital. Means of financing, Term Loans, Financial Institutions. Profitability - Cost of Production, Break-even analysis. Assessing the tax burden and financial projections. (9 hours)

Unit V : Forms of Project Organization, Project Planning, Implementation, and Control - Network construction, CPM, PERT, Development of Project schedule, Crashing of Project Network, Scheduling based on the availability of Resources (Manpower and Release of Funds).
Introduction to Foreign collaboration projects - Governmental policy framework, Need for foreign technology, Royalty payments, Foreign investments and procedural aspects. (9 hours)

TEXT BOOKS :

1. Prasanna Chandra, Projects - Preparation, Appraisal, Budgeting and Implementation, Tata McGraw Hill Publishing Company Ltd., New Delhi, 7th Edition, 2009.
2. P.Gopalakrishnan and V.E.Rama Moorthy - Project Management, Macmillan India Ltd., New Delhi, 1993.

REFERENCE BOOKS :

1. R.C.Mishra and Tarun Soota - Modern Project Management, New Age International (P) Ltd, New Delhi, 2nd Edition, 2010.
2. Goel, B.B., Project Management - Principles and Techniques, Deep & Deep Publications, New Delhi, 2002.
3. UNIDO Series on Project Management.

E LEARNING RESOURCES :

1. www.nptel.ac.in
2. Albert Lester – Project Management: Planning and Control, Elsevier, 5th Edition, 2007.
3. John M Nicholas and Herman Steyn – Project Management for Engineering, Business and Technology, Elsevier, 4th Edition, 2012.
4. Project Management Institute - A Guide to Project Management Body of Knowledge, Project Management Institute, 5th Edition, 2013.

MEE 88 ROBUST DESIGN

OBJECTIVES

- *To make the students to learn the basic concepts of experimental design*
- *To train the students in different methods of experimental design*

Unit – I
Basic Concepts – Fundamentals of experimental design, Selection of an appropriate design, Criteria for evaluation, Factors and levels, Review of statistical inference – Importance of optimized design – Functional design – Parametric design

Unit – II
Single factor experiments: Completely randomized design, Analysis of variance (ANOVA), Effect of total sum of Squares, Randomized block design, Randomized incomplete block design,Latin square design.

Unit – III
Factorial experiments: Two way analysis of variance, Fixed, Random and Mixed models, Expected mean square rules, Nested and nested factorial designs, Effect of confounding, Fractional factorial design – response surface methodology: The method of steepest ascent, response, Surface designs.

Unit – IV
Steps in designing performance in to a product – Taguchi's definition of quality – Loss functions and manufacturing tolerances – Additivity – orthogonal arrays vs. classical statistical experiments–– Graphic evaluations of main effects – Selecting factors for Taguchi Experiments.

Unit – V
Concept of S/N Ratios – Its significance in robust design – Case studies of S/N ratios in optimization – Identifying control and noise factors- Ishikawa Diagram- Constrained Robust-Design Approach – Applications.

REFERENCE BOOKS:
1. Douglus C.Montgomery - Design and Analysis of Experiments, John Wiley & Sons, 1984.
2. Charles R.Hicks, - Fundamental Concepts in design of experiments,1984. Holt, Rinehort and Winston
3. Tapan P.Bagchi, - Methods Explained: Practical steps to Robust Design, Prentice Hall of India Private Limited, New Delhi,1993.

E-learning source:

http://ocw.mit.edu/courses/aeronautics-and-astronautics/16-881-robust-system-design-summer-1998/lecture-notes/

MEE89 SYSTEM DESIGN & OPTIMIZATION IN THERMAL ENGINEERING
(3 1 0 4)

OBJECTIVES

- *To review the fundamentals of Thermodynamics, Fluid Mechanics and Heat Transfer*
- *To mathematically model the energy system components*
- *To simulate the non linear single and multi variable equations using NR Method*
- *To apply optimization techniques in Energy Systems Simulation*
- *To get insight into the techniques of pinch analysis*
- *To understand the relevance of EGM in Energy Systems Design*

UNIT – I

Steps in design process – thermal system design aspects – workable – optimal – near optimal designs – regression analysis and equation fitting – importance of modeling in design – types of models – selection – Introduction to Engineering Equation Solver - Modeling and design of piping system. (9 hours)

UNIT – II

Modeling of thermal equipment – heat exchangers – evaporators – condensers – turbo machines – pump system operation – Fans - distillation columns – System simulation – different classes – methods used in simulation – examples of energy systems – Refrigeration systems – vapor compression – vapor absorption - liquefaction. (9 hours)

UNIT – III

Optimization of thermal systems – analytical and numerical optimization techniques – unconstrained and constrained multivariable optimization using Lagrange Multipliers and search methods – application to energy systems – Introduction to Cycle Tempo - modeling combustion – gas turbine power plant – steam turbine power plant – design optimization of cogeneration system – Fuel Cells. (9 hours)

UNIT – IV

Optimization of heat exchanger networks – concepts of pinch technology – temperature enthalpy rate difference diagram – composite curves and process pinch – maximum energy recovery – calculation of utility loads – grand composite curve – estimation of the required total heat transfer surface area – HEN design – integration of HEN with other components. (9 hours)

UNIT – V

Applications of second law analysis in heat and fluid flow – relationship between entropy
generation and viscous dissipation – local entropy generation in convective heat transfer – fluid friction vs. heat transfer irreversibility – Bejan number - entropy generation minimization in extended surfaces and heat exchangers subject to constraints – Electronic cooling – Storage systems – Power maximization or entropy generation minimization. (9 hours)

Text Books:

1. A.Bejan, Advanced Engineering Thermodynamics, Wiley, 2006.
2. W.F.Stoecker, Design of Thermal Systems, McGraw Hill Book Co., 1989.

Reference Books:

1. Y.Jaluria, Design and Optimization of Thermal Systems, McGraw Hill, 2007.
2. A.Bejan et al, Thermal Design and Optimization, John Wiley & Sons, 1996.
3. Hodge, B. K., and Taylor, R. P., Analysis and Design of Energy Systems, Prentice Hall, 1999.
4. B.Linhoff et al, User Guide on Process Integration for Efficient use of Energy, IChE, 1984.

Web Resources:

1. https://www.coursera.org/course/optimization
2. http://nptel.ac.in/courses/103107096
3. http:// ocw.mit.edu/courses/chemical-engineering/10-492-1-integrated-chemical-engineering-topics-i-process-control-by-design-fall-2004/

MEE810 TOTAL QUALITY MANAGEMENT (4 0 0 4)

COURSE OBJECTIVES

To introduce students with the TQM concepts, techniques and various process analysis tools, international standards, and expose students to organizational TQM implementation techniques and continuous quality improvement.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

1. Use seven QC tools for data collection and analysis
2. Audit the quality system and take corrective actions when necessary
3. Advise management for the TQM approach development.
4. Implement the TQM approach in an organization for continuous quality improvement.
5. Assess where an organization stands on quality management with respect to various quality standards

SYLLABUS:

Unit I : Introduction to TQM – Strategies concepts and objectives – Total quality model – TQM as applied to Indian Industries – Quality circle concepts – concepts, objectives and functions of quality circles – Benefits of the organization – Training of quality Circle members – Implementation. (9 hours)

Unit II : Tools and Techniques – The seven management tools - Technique for analyzing a quality process – Statistical process Control (9 hours)

Unit III : Cost of quality – Taguchi's quality loss function – House keeping concepts for industries, tool room, production shop – processing industries. (9 hours)

Unit IV : Quality based product and process Design – Design for reliability – Design for maintainability – Quality Function Deployment (QFD) – QFD and Quality Assurance – QFD Principles, Concepts and applications – case studies. (9 hours)

Unit V : Introduction to SQC concepts- KAIZEN Concepts – Kaizen by TQC – POKA YOKE - IS 9000-QS9000,14000 concepts- certification system – 9001 to 9004 systems – procedures, audits and reviews – Lean manufacturing systems- Toyota production concepts-case studies. (9 hours)

TEXT BOOKS :

1. Dale H.Besterfiled, et al. - Total Quality Management, Pearson Education Asia, 3rd Edition, 2006.
2. P.N.Mukherjee – Total Quality Management, Prentice Hall of India Ltd., New Delhi, 2006.
3. James R Evans and William M Lindsay – Quality Control and Management, Centage Learning India Pvt. Ltd., New Delhi, 2008.

REFERENCE BOOKS :

1. S.M.Sundara Raja - Total Quality Management, Tata Mc Graw Hill, 1998.
2. Patrick.J.Sweeney(Editor) - TQM for Engineering, Quality Resources, New York, 1993.

3. John Bank - The Essence of Total Quality Management, Prentice Hall of India, 1998.
4. James I Bossert - Quality Function Deployment, ASQC Quality Press, Wisconsin, 1994.
5. Kanishka Bedi – Quality Management, Oxford University Press, 8th Impression, 2011.
6. Poornima M Charantimath – Total Quality Management, First Indian Print, 2003.

E LEARNING RESOURCES :

1. www.nptel.ac.in

INFRASTRUCTURE
AND FACULTY
REQUIREMENTS

INFRASTRUCTURE AND FACULTY REQUIREMENTS FOR I YEAR B TECH. PROGRAMME

Space requirement:

Sl. No.	Classroom / Laboratory	Batch size	Area (Sqm)	No. required
01.	Classroom	66	66	Total intake / 60
02.	Drawing hall	66	175	1
03.	Physics Laboratory	30	150	1
04.	Chemistry Laboratory	30	150	1
05.	Basic Electrical Laboratory	15	75	1
06.	Basic Electronics Laboratory	15	75	1
07.	Computer Laboratory	30	150	1
08.	Workshop practice	30	200	1

Requirement of Teaching and Non-Teaching Staff:

Teaching:

The number of faculty members required would be as per AICTE norms and course curriculum.

Faculty: Student ratio = 1 : 15

A minimum of two faculty members in each of the following disciplines are required

(i) Maths
(ii) Physics
(iii) Chemistry
(iv) Mechanical

A minimum of one faculty member in each of the following disciplines are required

(i) English
(ii) Electrical & Electronics Engineering / Electronics and Communication Engineering
(iii) Civil Engineering
(iv) Computer Science and Engineering

Non-Teaching:

Total number of non-teaching staff (includes technical & ministerial) shall be in the ratio of ***Teaching : Non-teaching = 1: 1.2***

FACULTY QUALIFICATION:

(As per UGC / AICTE regulations and norms)

Science and Humanities

Minimum qualification: A first class Master degree in the respective discipline with Net qualification / M.Phil / Ph.D.

Engineering discipline

Minimum qualification: A first class ME / M.Tech degree in the respective discipline.

COMPUTER PROGRAMMING LABORATORY

(For a batch of 30 students)

Hardware

1. 1 No. of computer system : Server
2. 35 Nos. of computer system : Node with Pentium 4 or above processor
3. 1 UPS 5KVA
4. Dot Matrix Printer / Laser Printer – 3 Nos.
5. Node with Pentium 4 or above processor

Software

1. Licensed Microsoft Server OS / Linux Server OS / UNIX Server Software / Any other open source server software.
2. Licensed client OS / Open source client OS for minimum of 30 user.
3. Borland ‘C’ Compiler / Microsoft ‘C’ Compiler with 30 user license
4. MS Office / any other open source word processor, spread sheet and presentation software with 30 user license.

BASIC ELECTRICAL AND ELECTRONICS LABORATORY

(For a batch of 30 students)

Electrical

1. 15 boards
2. 15 tool sets
   Each set includes Screw Driver, Poker, Cuttingplier, Tester, Knife etc.
3. Accessories such as PVC pipes, boards, Ts, Wires (Single and multispread) electrical accessories like switcher (SPST, SPDT, OPDT), lamp holders, bulbs etc.
4. Demo experiment with few workshop tools – fan, tubelight, wiring etc.

Electronics

1.	Regulated power supply (0-15v)	-	2
2.	Signal Generator (0-1 MHz)	-	2
3.	CRO (20 MHz)	-	2
4.	Digital IC trainer kit	-	1
5.	Transformer (230/6,230/12)	-	2
6.	Strain gauge / thermocouple / LVDT Transducer Kit	-	1

PHYSICS LABORATORY

(For a batch of 30 students)

List of Major equipments required

1.	Lee's Disc Apparatus	-	3 nos.
2.	Calorimeter with stirrer	-	6 nos.
3.	Spectrometer	-	6 nos.
4.	Travelling Microscope	-	6 nos.
5.	Laurent Halt Shade Polarimeter	-	3 Nos.
6.	Jolly Bulb apparatus	-	3 Nos.
7.	Deflection Magnetometer	-	3 Nos.
8.	He Ne Laser	-	3 Nos.
9.	Stop watch, Vernier Caliper, Screw Gauge	-	6 nos. each
10.	Electronic Weighing Machine	-	2 Nos.

CHEMISTRY LABORATORY
(For a batch of 30 students)

1.	Burette		-	35 nos.
2.	Pipette		-	35 nos.
3.	Conical Flask		-	35 nos.
4.	Wash bottle 500 ml		-	35 nos.
5.	Funnel		-	35 nos.
6.	Volumetric flask	1000ml	-	5 nos.
		100 ml	-	70 nos.
7.	Beakers	1000 ml	-	10 nos.
		500 ml	-	10 nos.
		250 ml	-	70 nos.
		100 ml	-	15 nos.
8.	Reagent bottle	5000 ml	-	5 nos.
		250 ml	-	35 nos.
		60 ml	-	35 nos.
9.	Measuring jar	100 ml	-	10 nos.
		25 ml	-	10 nos.
		10 ml	-	10 nos.
		5 ml	-	10 nos.
		2 ml	-	10 nos.
10.	Round bottom flask	250 ml	-	35 nos.
11.	Condenser 300 mm		-	35 nos.
12.	COD bottle		-	5 nos.

Equipments

1.	Electronic weighing balance 0.1mg – 200 gm		-	2 nos.
2.	Conductivity meters		-	7 nos.
3.	Calorimeter		-	7 nos.
4.	Potentiometer		-	7 nos.
5.	Hot plates		-	7 nos.
6.	Polythene cans	10 liters	-	10 nos.
		5 liters	-	10 nos.
7.	Viscometers		-	35 nos.
8.	Burners		-	35 nos.
9.	Water distillation plant 5 lit cap		-	1 no.
10.	Burette stand with clamp		-	35 nos.

BASIC WORKSHOP

(For a batch of 30 students)

1. Work benches fitted with bench-wise / carpentry wise of 8 for a batch size of 30.
2. Fitting tools – 8 sets
3. Carpentry tools – 8 sets
4. Welding tools – 8 sets
5. Sheet metal tools -8 sets
6. Power hacksaw – 1 no.
7. Drilling machine – 1 no.
8. Anvil – 1 no.
9. Welding work tables – 2 nos.
10. Welding Transformer – 2 nos.
11. Hand shear for sheet metal
12. Pedestal Grinder
13. Surface table with light gauge
14. Different stag for forming shapes

INFRASTRUCTURE AND FACULTY REQUIREMENT FOR B TECH (MECHANICAL ENGINEERING) FROM III SEMESTER TO VIII SEMESTER

Requirement of Teaching and Non-teaching staff

Teaching

The number of faculty members required would be as per AICTE norms and course curriculum

Faculty : Student ratio = 1:15

Minimum Qualification:

A First Class M E/M Tech degree in Mechanical Engineering

Non-Teaching:

Total number of non-teaching staff (includes technical and ministerial) shall be in the ratio of

Teaching : Non Teaching = 1:1.2

Requirement of Class Rooms:

For a batch of 66 students (intake) three class rooms of 66 square meters are required.

FOLLOWING IS THE INFRASTRUCTURE REQUIRED FOR VARIOUS LABORATORIES FOR A BATCH SIZE OF 22

MATERIAL TESTING AND METALLURGY LAB:

Space requirement: 100m^2
Major equipment:

UTM – 10 ton capacity with necessary accessories
Rockwell Hardness Testing Machine
Brinell Hardness Testing Machine
Impact Testing Machine
Metallurgical Microscopes (3 Nos.)
Lapping machine
Muffle Furnace (Range up to 1000^{0}C)
Jominy quenching apparatus
Pedestal Grinding machine
Fine Polishing machine

Reference:

1. Manufacturing Processes for Engineering Materials, Fourth Edition by Serope Kalpakjian, Steven R.Schmid
2. Engineering Materials & Metallurgy – 1 Jan 2012 by Dr. Rakesh Dogra , Arvind Sharma.
3. A Textbook of Engineering Material and Metallurgy by Amandeep Singh Wadhwa, Er. Harvinder Singh Dhaliwal

MACHINE SHOP:

The following Laboratories will be held in this Lab
Manufacturing Process Laboratory – I
Manufacturing Process Laboratory – II
Manufacturing Process Laboratory – III

Space requirement: Total Space for three Labs is 600m^2

Manufacturing Process Laboratory – I : 200m^2
Manufacturing Process Laboratory – II : 200m^2
Manufacturing Process Laboratory – III : 200m^2

MAJOR EQUIPMENT REQUIRED:

Manufacturing Process Laboratory – I

Lathe Machines : 8 Nos.
Shaping Machines : 2 Nos.
Universal Horizontal milling Machine : 1 No.

Manufacturing Process Laboratory – II

Pillar Drilling Machine : 1 No.

Radial Drilling Machine	: 1 No.
Cylindrical grinding machine	: 1 No.
Surface grinding Machine	: 1 No.

Manufacturing Process Laboratory – III

Foundry tools & accessories	: 4 sets
Crucible Furnace	: 1 No.
Gear Hobbing Machine	: 1 No.
Tool and Cutter grinder	: 1 No.
CNC – Turning center (Trainer Model)	: 1 No.
CNC - Milling center (Trainer Model)	: 1 No.

FLUID MACHINERY LAB:

Space requirement: 100 m^2

Major equipment:
Setup to determine Centrifugal Pump performance.
Setup to determine Self-priming Pump performance.
Setup to determine Reciprocating Pump performance.
Setup to determine Jet Pump performance.
Setup to determine Submersible Pump performance.
Setup to determine Vertical Turbine Pump performance.
Setup to determine performance of pumps in series and parallel.
Setup to determine Gear Pump performance.
Setup to determine Characteristics of a Pelton Wheel Turbine.
Setup to determine Characteristics of a Francis Turbine.
Setup to determine Characteristics of a Kaplan Turbine.
Setup to determine Characteristics of a Vacuum pump.

Thermal Engineering Lab:

Space requirement: 400 m^2

Major equipment:

Redwood Viscometer
Cleaveland apparatus to determine Flash and Fire Points
Bomb Calorimeter and accessories to determine Calorific value of Solid or Liquid Fuel
Junker's Gas Calorimeter to determine Calorific value of a gaseous fuel
Setup to determine the performance of a two-stage reciprocating air compressor
Setup to determine the performance of a centrifugal air blower
Orsat apparatus with necessary chemicals and accessories to find the composition of exhaust gas
Setup to determine the thermal resistance and conductivity of a Composite wall
Setup to determine the natural convective heat transfer coefficient from a vertical cylinder
Setup to determine the forced convective heat transfer coefficient from a cylindrical surface
Setup to find the performance of pin fins subjected to forced or natural convection
Setup to find the performance of parallel flow/Counter flow Heat Exchanger
Setup to obtaining valve timing/port timing diagrams
Single cylinder petrol engine test rig to conduct load test
Multi-cylinder petrol engine test rig to conduct load test, Morse test and to draw heat balance
Single cylinder 4 stroke diesel engine test rig to conduct load test
Multi-cylinder diesel engine test rig to conduct load test and to draw heat balance
Exhaust gas analyzer/Gas Chromatograph
Setup to find the performance of a Cooling tower
Setup to find the performance of a refrigeration system
Setup to find the performance of an air conditioning system
Non IBR Boiler with all equipment to conduct performance test of the boiler
Steam turbine and equipment to conduct performance test
Separating and throttling calorimeter to determine the dryness of steam

DYNAMICS OF MACHINES LAB:

Space requirement: 100 m^2

Major Equipment:

Vibration test setup to conduct experiments on spring mass systems, torsional vibration systems and damped torsional vibration system.
Setup to determine radius of gyration a compound pendulum
Setup to determine radius of gyration and moment of inertia using bifilar, trifiler suspension methods
Setup to conduct experiments on equivalent spring mass system (un-damped and damped)
Setup to determine characteristics of Watt, Porter, Proell and spring loaded governors
Setup to determine Static and Dynamic Balancing of a rotating system
Setup to study critical speed of a rotating shaft
Journal bearing setup to find the pressure distribution
Setup to find cam profile and its motion analysis
Setup to determine Gyroscope couple
Involute gear tooth profile generator setup

MEASUREMENT AND METROLOGY LAB:

Space requirement: 100 m^2

Micrometers – 4 Nos.
Sine bar to measure taper
Different plug gauges
Autocollimator
Setup to measure surface roughness
Setup and accessories to inspect screw threads using effective diameter method
Profile projector to inspect gear tooth
Tool maker microscope
CMM
Setup to calibrate inclined tube manometer
Experimental setup for measuring force using transducers
Setup to measure pressure using strain gauges
Determination of time constant of thermocouple temperature measuring system
Stroboscope set up to measure speed
Setup to measure strain using strain gauges
LVDT for displacement measurement
Setup to measure vibration using accelerometer

COMPUTING LAB:

Space requirement: 150 m^2

The following Laboratories will be held in this Lab.
Computational Methods Lab, Computer Aided Machine Drawing, CAD Lab

Major Equipment and software:

CAD software: CATIA/Pro-E or equivalent Open source software
FEA software: ANSYS/Hyperworks/Abacus/NISA or any equivalent open source software
TK solver
Engineering Equation Solver
Software having AutoLisp
Server – 1 No.
PIV system with a min. of 1GB RAM and a graphics card – 25 Nos.
Plotter (A1 size) – 1 No.
Color printer – 1 No.
Printers – 1 No.
UPS to support the server and systems