

Evaluation Scheme & Syllabus for

B. Tech.

Mechanical Engg.

as per AKTU and AICTE Model Curriculum

(Effective from the Session: 2018-19)

**B. Tech 1st Year
Mechanical Engg. Structure
w.e.f. Session 2018-19**

SEMESTER - I

Sl. No	Code	SUBJECT	PERIODS			EVALUATION SCHEME				END SEMESTER		TOTAL	CREDIT
			L	T	P	CT	TA	Total	PS	TE	PE		
3 WEEKS COMPULSORY INDUCTION PROGRAM													
1	KAS101/ KAS102	Physics/Chemistry	3	1	3	30	20	50	25	100	25	200	5.5
2	KAS103	Mathematics-I	3	1	0	30	20	50	-	100	-	150	4
3	KEE 101/ KCS101	Basic Electrical Engineering/Programming for Problem Solving	3	1	2	30	20	50	25	100	25	200	5
4	KCE101/ KWS101	Engineering Graphics & Design/Workshop Practices	1	0	4	-	-	-	25	-	25	50	3
	MOOCs (For B.Tech. Hons. Degree)*												0
		TOTAL										600	17.5

SEMESTER II

Sl. No.	Code	SUBJECT	PERIODS			EVALUATION SCHEME				END SEMESTER		TOTAL	CREDIT
			L	T	P	CT	TA	Total	PS	TE	PE		
1	KAS201/ KAS202	Physics/Chemistry	3	1	3	30	20	50	25	100	25	200	5.5
2	KAS203	Mathematics II	3	1	0	30	20	50	-	100	-	150	4
3	KEE201/ KCS201	Basic Electrical Engineering/Programming for Problem Solving	3	1	2	30	20	50	25	100	25	200	5
4	KCE201/ KWS201	Engineering Graphics & Design/Workshop Practices	1	0	4	-	-	-	25	-	25	50	3
5	KAS204	Professional English	2	0	2	30	20	50	-	100	-	150	3
	MOOCs (For B.Tech. Hons. Degree)*												0
	TOTAL												750
													20.5

Mini Project or Internship (3-4 weeks) shall be conducted during summer break after II semester and will be assessed during III semester

*** List of MOOCs (NPTEL) Based Recommended Courses for first year B. Tech Students**

1. Developing Soft Skills and personality-Odd Semester-8 Weeks-3 Credits
2. Enhancing Soft Skills and personality-Even Semester-8 Weeks-3 Credits

*** AICTE Guidelines in Model Curriculum:**

After successful completion of 160 credits, a student shall be eligible to get Under Graduate degree in Engineering. A student will be eligible to get Under Graduate degree with Honours only, if he/she completes additional university recommended courses only (Equivalent to 20 credits; NPTEL Courses of 4 Weeks, 8 Weeks and 12 Weeks shall be of 2, 3 and 4 Credits respectively) through MOOCs. For registration to MOOCs Courses, the students shall follow NPTEL Site <http://nptel.ac.in/> as per the NPTEL policy and norms. The students can register for these courses through NPTEL directly as per the course offering in Odd/Even Semesters at NPTEL. These NPTEL courses (recommended by the University) may be cleared during the B. Tech degree program (not necessary one course in each semester). After successful completion of these MooCs courses the students, shall, provide their successful completion NPTEL status/certificates to the University (COE) through their college of study only. The student shall be awarded Hons. Degree (on successful completion of MOOCS based 20 credit) only if he/she secures 7.50 or above CGPA and passed each subject of that Degree Programme in single attempt without any grace marks.

SEMESTER - I

A Guide to Induction Program

1 Introduction

(Induction Program was discussed and approved for all colleges by AICTE in March 2017. It was discussed and accepted by the Council of IITs for all IITs in August 2016. It was originally proposed by a Committee of IIT Directors and accepted at the meeting of all IIT Directors in March 2016.¹ This guide has been prepared based on the Report of the Committee of IIT Directors and the experience gained through its pilot implementation in July 2016 as accepted by the Council of IITs. Purpose of this document is to help institutions in understanding the spirit of the accepted Induction Program and implementing it.)

Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his study. However, he must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he would understand and fulfill his responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed.

There is a mad rush for engineering today, without the student determining for himself his interests and his goals. This is a major factor in the current state of demotivation towards studies that exists among UG students. The success of gaining admission into a desired institution but failure in getting the desired branch, with peer pressure generating its own problems, leads to a peer environment that is demotivating and corrosive. Start of hostel life without close parental supervision at the same time, further worsens it with also a poor daily routine.

To come out of this situation, a multi-pronged approach is needed. One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them

A Committee of IIT Directors was setup in the 152nd Meeting of IIT Directors on 6th September 2015 at IIT Patna, on how to motivate undergraduate students at IITs towards studies, and to develop verbal ability. The Committee submitted its report on 19th January 2016. It was considered at the 153rd Meeting of all IIT Directors at IIT Mandi on 26 March 2016, and the accepted report came out on 31

March 2016. The Induction Program was an important recommendation, and its pilot was implemented by three IITs, namely, IIT(BHU), IIT Mandi and IIT Patna in July 2016. At the 50th meeting of the Council of IITs on 23 August 2016, recommendation on the Induction Program and the report of its pilot implementation were discussed and the program was accepted for all IITs, work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character.

2. Induction Program

When new students enter an institution, they come with diverse thoughts, backgrounds and preparations. It is important to help them adjust to the new environment and inculcate in them the ethos of the institution with a sense of larger purpose. Precious little is done by most of the institutions, except for an orientation program lasting a couple of days.

We propose a 3-week long induction program for the UG students entering the institution, right at the start. Normal classes start only after the induction program is over. Its purpose is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.²

The time during the Induction Program is also used to rectify some critical lacunas, for example, English background, for those students who have deficiency in it. The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

2Induction Program as described here borrows from three programs running earlier at different institutions: (1) Foundation Program running at IIT Gandhinagar since July 2011, (2) Human Values course running at IIIT Hyderabad since July 2005, and (3) Counselling Service or mentorship running at several IITs for many decades. Contribution of each one is described next.

1. IIT Gandhinagar was the first IIT to recognize and implement a special 5-week Foundation Program for the incoming 1st year UG students. It took a bold step that the normal classes would start only after the five week period. It involved activities such as games, art, etc., and also science and other creative workshops and lectures by resource persons from outside.
2. IIIT Hyderabad was the first one to implement a compulsory course on Human Values. Under it, classes were held by faculty through discussions in small groups of students, rather than in lecture mode. Moreover, faculty from all departments got involved in conducting the group discussions under the

course. The content is non-sectarian, and the mode is dialogical rather than sermonising or lecturing. Faculty were trained beforehand, to conduct these discussions and to guide students on issues of life.

3. Counselling at some of the IITs involves setting up mentor-mentee network under which 1st year students would be divided into small groups, each assigned a senior student as a student guide, and a faculty member as a mentor. Thus, a new student gets connected to a faculty member as well as a senior student, to whom he/she could go to in case of any difficulty whether psychological, financial, academic, or otherwise.

The Induction Program defined here amalgamates all the three into an integrated whole, which leads to its high effectiveness in terms of building physical activity, creativity, bonding, and character. It develops sensitivity towards self and one's relationships, builds awareness about others and society beyond the individual, and also in bonding with their own batch-mates and a senior student besides a faculty member.

Scaling up the above amalgamation to an intake batch of 1000 plus students was done at IIT(BHU), Varanasi starting from July 2016.

2.1 Physical Activity

This would involve a daily routine of physical activity with games and sports. It would start with all students coming to the field at 6 am for light physical exercise or yoga. There would also be games in the evening or at other suitable times according to the local climate. These would help develop team work. Each student should pick one game and learn it for three weeks. There could also be gardening or other suitably designed activity where labour yields fruits from nature.

2.2 Creative Arts

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it every day for the duration of the program.

These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, flow into engineering design later.

2.3 Universal Human Values

It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of

relationships with colleagues and supporting staff in the hostel and department, be sensitive to others, etc. Need for character building has been underlined earlier. A module in Universal Human Values provides the base.

Methodology of teaching this content is extremely important. It must not be through do's and don't's, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. The role of group discussions, however, with clarity of thought of the teachers cannot be over emphasized. It is essential for giving exposure, guiding thoughts, and realizing values.

The teachers must come from all the departments rather than only one department like HSS or from outside of the Institute. Experiments in this direction at IIT(BHU) are noteworthy and one can learn from them.³

Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It is to open thinking towards the self. Universal Human Values discussions could even continue for rest of the semester as a normal course, and not stop with the induction program.

Besides drawing the attention of the student to larger issues of life, it would build relationships between teachers and students which last for their entire 4-year stay and possibly beyond.

The Universal Human Values Course is a result of a long series of experiments at educational institutes starting from IIT-Delhi and IIT Kanpur in the 1980s and 1990s as an elective course, NIT Raipur in late 1990s as a compulsory one-week off campus program. The courses at IIT(BHU) which started from July 2014, are taken and developed from two compulsory courses at IIIT Hyderabad first introduced in July 2005.

2.4 Literary

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

2.5 Proficiency Modules

This period can be used to overcome some critical lacunas that students might have,

for example, English, computer familiarity etc. These should run like crash courses, so that when normal courses start after the induction program, the student has overcome the lacunas substantially. We hope that problems arising due to lack of English skills, wherein students start lagging behind or failing in several subjects, for no fault of theirs, would, hopefully, become a thing of the past.

2.6 Lectures by Eminent People

This period can be utilized for lectures by eminent people, say, once a week. It would give the students exposure to people who are socially active or in public life.

2.7 Visits to Local Area

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

2.8 Familiarization to Dept./Branch & Innovations

The students should be told about different method of study compared to coaching that is needed at IITs. They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

3 Schedule

The activities during the Induction Program would have an Initial Phase, a Regular Phase and a Closing Phase. The Initial and Closing Phases would be two days each.

3.1 Initial Phase

Time	Activity
Day 0	
Whole day	Students arrive - Hostel allotment. (Preferably do pre allotment)
Day 1	
09:00 am - 03:00 pm	Academic registration
04:30 pm - 06:00 pm	Orientation
Day 2	
09:00 am - 10:00 am	Diagnostic test (for English etc.)
10:15 am - 12:25 pm	Visit to respective depts.
12:30 pm - 01:55 pm	Lunch
02:00 pm - 02:55 pm	Director"s address
03:00 pm - 05:00 pm	Interaction with parents
03:30 pm - 05:00 pm	Mentor-mentee groups - Introduction within group. (Same as Universal Human Values groups)

3.2 Regular Phase

After two days is the start of the Regular Phase of induction. With this phase there would be regular program to be followed every day.

3.2.1 Daily Schedule

Some of the activities are on a daily basis, while some others are at specified periods

within the Induction Program. We first show a typical daily timetable.

Session. Time Activity Remarks Day 3 onwards

	06:00 am	Wake up call	
I	06:30 am - 07:10 am	Physical activity (mild exercise/ yoga)	
	07:15 am - 08:55 am	Bath, Breakfast, etc.	
II	09:00 am - 10:55 am	Creative Arts / Universal Human Values	Half the groups do Creative Arts
III	11:00 am - 12:55 pm	Universal Human Values/ Creative Arts	Complementary alternate
	01:00 pm - 02:25 pm	Lunch	
IV	02:30 pm - 03:55 pm	Afternoon Session See below.	
V	04:00 pm - 05:00 pm	Afternoon Session See below.	
	05:00 pm - 05:25 pm	Break / light tea	
VI	05:30 pm - 06:45 pm	Games / Special Lectures	
	06:50 pm - 08:25 pm	Rest and Dinner	
VII	08:30 pm - 09:25 pm	Informal interactions (in hostels)	

Sundays are off. Saturdays have the same schedule as above or have outings.

3.2.2 Afternoon Activities (Non-Daily)

The following five activities are scheduled at different times of the Induction Program, and are not held daily for everyone:

1. Familiarization to Dept./Branch & Innovations
2. Visits to Local Area
3. Lectures by Eminent People
4. Literary
5. Proficiency Modules

Here is the approximate activity schedule for the afternoons (may be changed to suit local needs):

Activity	Session	Remarks
Familiarization with Dept/Branch & Innovations	IV	For 3 days (Day 3 to 5)
Visits to Local Area	IV, V and VI	For 3 days - interspersed (e.g., 3 Saturdays)
Lectures by Eminent People	IV	As scheduled - 3-5 lectures
Literary (Play / Book	IV	For 3-5 days

Reading / Lecture)
Proficiency Modules

V

Daily, but only for those who need it

3.3 Closing Phase

Time

Activity

Last But One Day

08:30 am - 12 noon

Discussions and finalization of presentation within each group

02:00 am - 05:00 pm

Presentation by each group in front of 4 other groups besides their own (about 100 students)

Last Day

Whole day

Examinations (if any). May be expanded to last 2 days, in case needed.

3.4 Follow Up after Closure

A question comes up as to what would be the follow up program after the formal 3-week Induction Program is over? The groups which are formed should function as mentor mentee network. A student should feel free to approach his faculty mentor or the student guide, when facing any kind of problem, whether academic or financial or psychological etc. (For every 10 undergraduate first year students, there would be a senior student as a student guide, and for every 20 students, there would be a faculty mentor.) Such a group should remain for the entire 4-5 year duration of the stay of the student. Therefore, it would be good to have groups with the students as well as teachers from the same department/discipline. Here we list some important suggestions which have come up and which have been experimented with.

3.4.1 Follow Up after Closure – Same Semester

It is suggested that the groups meet with their faculty mentors once a month, within the semester after the 3-week Induction Program is over. This should be a scheduled meeting shown in the timetable. (The groups are of course free to meet together on their own more often, for the student groups to be invited to their faculty mentor's home for dinner or tea, nature walk, etc.)

3.4.2 Follow Up – Subsequent Semesters

It is extremely important that continuity be maintained in subsequent semesters. It is suggested that at the start of the subsequent semesters (upto fourth semester), three days be set aside for three full days of activities related to follow up to Induction Program. The students be shown inspiring films, do collective art work, and group discussions be conducted. Subsequently, the groups should meet at least once a month.

4 Summary

Engineering institutions were set up to generate well trained manpower in engineering with a feeling of responsibility towards oneself, one's family, and society. The incoming undergraduate students are driven by their parents and society to join engineering without understanding their own interests and talents. As a result, most students fail to link up with the goals of their own institution.

The graduating student must have values as a human being, and knowledge and meta skills related to his/her profession as an engineer and as a citizen. Most students who get demotivated to study engineering or their branch, also lose interest in learning.

The Induction Program is designed to make the newly joined students feel comfortable, sensitize them towards exploring their academic interests and activities, reducing competition and making them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and building of character.

The Universal Human Values component, which acts as an anchor, develops awareness and sensitivity, feeling of equality, compassion and oneness, draw attention to society and we are aware that there are advantages in mixing the students from different depts. However, in mixing, it is our experience that the continuity of the group together with the faculty mentor breaks down soon after. Therefore, the groups be from the same dept. but hostel wings have the mixed students from different depts. For example, the hostel room allotment should be in alphabetical order irrespective of dept. nature, and character to follow through. It also makes them reflect on their relationship with their families and extended family in the college (with hostel staff and others). It also connects students with each other and with teachers so that they can share any difficulty they might be facing and seek help.

References:

Motivating UG Students Towards Studies, Rajeev Sangal, IITBHU Varanasi, Gautam Biswas, IIT Guwahati, Timothy Gonsalves, IIT Mandi, Pushpak Bhattacharya, IIT Patna, (Committee of IIT Directors), 31 March 2016, IIT Directors' Secretariat, IIT Delhi.

PHYSICS

Module - 1 Relativistic Mechanics:

[8]

Frame of reference, Inertial & non-inertial frames, Galilean transformations, Michelson-Morley experiment, Postulates of special theory of relativity, Lorentz transformations, Length contraction, Time dilation, Velocity addition theorem, Variation of mass with velocity, Einstein's mass energy relation, Relativistic relation between energy and momentum, Massless particle.

Module- 2 Electromagnetic Field Theory:

[8]

Continuity equation for current density, Displacement current, Modifying equation for the curl of magnetic field to satisfy continuity equation, Maxwell's equations in vacuum and in non conducting medium, Energy in an electromagnetic field, Poynting vector and Poynting theorem, Plane electromagnetic waves in vacuum and their transverse nature. Relation between electric and magnetic fields of an electromagnetic wave, Energy and momentum carried by electromagnetic waves, Resultant pressure, Skin depth.

Module- 3 Quantum Mechanics:

[8]

Black body radiation, Stefan's law, Wien's law, Rayleigh-Jeans law and Planck's law, Wave particle duality, Matter waves, Time-dependent and time-independent Schrodinger wave equation, Born interpretation of wave function, Solution to stationary state Schrodinger wave equation for one-Dimensional particle in a box, Compton effect.

Module- 4 Wave Optics:

[10]

Coherent sources, Interference in uniform and wedge shaped thin films, Necessity of extended sources, Newton's Rings and its applications. Fraunhofer diffraction at single slit and at double slit, absent spectra, Diffraction grating, Spectra with grating, Dispersive power, Resolving power of grating, Rayleigh's criterion of resolution, Resolving power of grating.

Module- 5 Fibre Optics & Laser:

[10]

Fibre Optics: Introduction to fibre optics, Acceptance angle, Numerical aperture, Normalized frequency, Classification of fibre, Attenuation and Dispersion in optical fibres. Laser: Absorption of radiation, Spontaneous and stimulated emission of radiation, Einstein's coefficients, Population inversion, Various levels of Laser, Ruby Laser, He-Ne Laser, Laser applications.

Course Outcomes:

1. To solve the classical and wave mechanics problems
2. To develop the understanding of laws of thermodynamics and their application in various processes
3. To formulate and solve the engineering problems on Electromagnetism & Electromagnetic Field Theory
4. To aware of limits of classical physics & to apply the ideas in solving the problems in their parent streams

Reference Books:

1. Concepts of Modern Physics - AurthurBeiser (Mc-Graw Hill)

2. Introduction to Special Theory of Relativity- Robert Resnick (Wiley)
3. Optics - Brijlal& Subramanian (S. Chand)
4. Engineering Physics: Theory and Practical- Katiyar and Pandey (Wiley India)
5. Applied Physics for Engineers- Neeraj Mehta (PHI Learning, New)
6. Engineering Physics-Malik HK and Singh AK (McGrawHill)

Physics Lab

List of Experiments

Any ten experiments (at least four from each group).

Group A

1. To determine the wavelength of sodium light by Newton's ring experiment.
2. To determine the wavelength of different spectral lines of mercury light using plane transmission grating.
3. To determine the specific rotation of cane sugar solution using polarimeter.
4. To determine the focal length of the combination of two lenses separated by a distance and verify the formula for the focal length of combination of lenses.
5. To measure attenuation in an optical fiber.
6. To determine the wavelength of He-Ne laser light using single slit diffraction.
7. To study the polarization of light using He-Ne laser light.
8. To determine the wavelength of sodium light with the help of Fresnel's bi-prism.
9. To determine the coefficient of viscosity of a given liquid.
10. To determine the value of acceleration due to gravity (g) using compound pendulum.

Group B

1. To determine the energy band gap of a given semiconductor material.
2. To study Hall effect and determine Hall coefficient, carrier density and mobility of a given semiconductor material using Hall effect setup.
3. To determine the variation of magnetic field with the distance along the axis of a current carrying coil and estimate the radius of the coil.
4. To verify Stefan's law by electric method.
5. To determine resistance per unit length and specific resistance of a given resistance using Carey Foster's Bridge.
6. To study the resonance condition of a series LCR circuit.
7. To determine the electrochemical equivalent (ECE) of copper.
8. To calibrate the given ammeter and voltmeter by potentiometer.
9. To draw hysteresis (B-H curve) of a specimen in the form of a transformer and to determine its hysteresis loss.
10. To measure high resistance by leakage method.

Reference Books

1. Practical Physics- K. K. Dey & B. N. Dutta (Kalyani Publishers New Delhi)
2. Engineering Physics-Theory and Practical- Katiyar& Pandey (Wiley India)
3. Engineering Physics Practical- S K Gupta (KrishnaPrakashan Meerut)

Course Outcomes:

1. To determine the wavelength of sodium light by Newton's ring experiment
2. To determine the wavelength of sodium light with the help of Fresnel's bi-prism
3. To determine the variation of magnetic field with the distance along the axis of a current carrying coil and estimate the radius of the coil.
4. To draw hysteresis (B-H curve) of a specimen in the form of a transformer and to determine its hysteresis loss.

CHEMISTRY

Module-1 [08]

Atomic and Molecular Structure:

Molecular orbital's of diatomic molecules. Band theory of solids. Liquid crystal and its applications. Point defects in solids. Structure and applications of Graphite and Fullerenes. Concepts of Nanomaterials and its application.

Module-2 [08]

Spectroscopic techniques and Applications:

Elementary idea and simple applications of Rotational, Vibrational, Ultraviolet& Visible and Raman spectroscopy.

Module-3 [08]

Electrochemistry

Nernst Equation and application, relation of EMF with thermodynamic functions (ΔH , ΔF and ΔS). Lead storage battery.

Corrosion; causes, effects and its prevention.

Phase Rule and its application to water system.

Module-4 [08]

Water Analysis; Hardness of water, Techniques for water softening (Lime-soda, Zeolite, Ion exchange resin and Reverse osmosis method).

Fuels: classification of fuels, Analysis of coal, Determination of calorific value (Bomb calorimeter and Dulong's methos).

Module-5 [08]

Polymer; Basic concepts of polymer-Blend and composites, Conducting and biodegradable polymers. Preparation and application of some industrially important polymers (Buna-S, Buna-N, Neoprene, Nylon-6, nylon-6,6 and Terylene). General methods of synthesis of organometallic compounds (Grignard reagent) and their applications.

Course Outcomes:

1. Use of different analytical instruments.
2. Measure molecular/system properties such as surface tension, viscosity, conductance of solution, chloride and iron content in water.
3. Measure hardness of water.
4. Estimate the rate constant of reaction.

Reference Books:

1. University Chemistry By B.H. Mahan
2. University Chemistry By C.N.R. Rao
3. Organic Chemistry By I.L. Finar
4. Physical Chemistry By S. Glasstone
5. Engineering Chemistry By S.S. Dara
6. Polymer Chemistry ByFre W., Billmeyer
7. Engineering ChemistryBy Satya Prakash

CHEMISTRY- PRACTICAL

LIST OF EXPERIMENTS

1. Determination of alkalinity in the given water sample.
2. Determination of temporary and permanent hardness in water sample using EDTA.
3. Determination of iron content in the given solution by Mohr's method.
4. Determination of viscosity of given liquid.
5. Determination of surface tension of given liquid.
6. Determination of chloride content in water sample.
7. Determination of available chlorine in bleaching powder.
8. Determination of pH by pH-metric titration.
9. Preparation of Phenol-formaldehyde and Urea-formaldehyde resin.
10. Determination of Cell constant and conductance of a solution.
11. Determination of rate constant of hydrolysis of esters.
12. Verification of Beer's law.

NOTE: Choice of any 10 experiments from the above. Institute can change any 02 experiments from the aforesaid experiments.

Course Outcomes:

1. Use of different analytical instruments.
2. Measure molecular/system properties such as surface tension, viscosity, conductance of solution, chloride and iron content in water.
3. Measure hardness of water.
4. Estimate the rate constant of reaction.

MATHEMATICS-I

(Common to all B. Tech. Courses except B. Tech. (Biotechnology)&B. Tech. (Agricultural Engineering))

Module 1: Matrices

[08]

Types of Matrices: Symmetric, Skew-symmetric and Orthogonal Matrices; Complex Matrices, Inverse and Rank of matrix using elementary transformations, Rank-Nullity theorem; System of linear equations, Characteristic equation, Cayley-Hamilton Theorem and its application, Eigen values and eigenvectors; Diagonalisation of a Matrix,

Module 2: Differential Calculus- I

[08]

Introduction to limits, continuity and differentiability, Rolle's Theorem, Lagrange's Mean value theorem and Cauchy mean value theorem, Successive Differentiation (n^{th} order derivatives), Leibnitz theorem and its application, Envelope, Involute and Evolute, Curve tracing: Cartesian and Polar co-ordinates

Module 3: Differential Calculus-II

[08]

Partial derivatives, Total derivative, Euler's Theorem for homogeneous functions, Taylor and Maclaurin's theorems for a function of one and two variables, Maxima and Minima of functions of several variables, Lagrange Method of Multipliers, Jacobians, Approximation of errors.

Module 4: Multivariable Calculus-I

[08]

Multiple integration: Double integral, Triple integral, Change of order of integration, Change of variables, **Application:** Areas and volumes, Center of mass and center of gravity (Constant and variable densities),

Module 5: Vector Calculus

[08]

Vector differentiation: Gradient, Curl and Divergence and their Physical interpretation, Directional derivatives, Tangent and Normal planes.

Vector Integration: Line integral, Surface integral, Volume integral, Gauss's Divergence theorem, Green's theorem, Stoke's theorem (without proof) and their applications.

COURSE OUTCOMES

1. Remember the concept of matrices and apply for solving linear simultaneous equations.
2. Understand the concept of limit, continuity and differentiability and apply in the study of Rolle,s , Lagrange,s and Cauchy mean value theorem and Leibnitz theorems .
3. Identify the application of partial differentiation and apply for evaluating maxima, minima, series and Jacobians.
4. Illustrate the working methods of multiple integral and apply for finding area, volume, centre of mass and centre of gravity.
5. Remember the concept of vector and apply for directional derivatives, tangent and normal planes. Also evaluate line, surface and volume integrals.

Text Books:-

1. B. V. Ramana, Higher Engineering Mathematics, Tata Mc Graw-Hill Publishing Company Ltd., 2008.
2. B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.
3. R K. Jain & S R K. Iyenger , Advance Engineering Mathematics, Narosa Publishing House 2002.

Reference Books-

- 1.E. Kreyszig, Advance Engineering Mathematics, John Wiley & Sons, 2005.
- 2.Peter V. O'Neil, Advance Engineering Mathematics, Thomson (Cengage) Learning, 2007.
- 3.Maurice D. Weir, Joel Hass, Frank R. Giordano, Thomas, Calculus, Eleventh Edition, Pearson.
- 4.D. Poole, Linear Algebra : A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
- 5.Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
- 6.Ray Wylie C and Louis C Barret, Advanced Engineering Mathematics, Tata Mc-Graw-Hill; Sixth Edition.
- 7.P. Sivaramakrishna Das and C. Vijayakumari, Engineering Mathematics, 1st Edition, Pearson India Education Services Pvt. Ltd
8. Advanced Engineering Mathematics. Chandrika Prasad, Reena Garg, 2018.
9. Engineering Mathemathics – I. Reena Garg, 2018.

Module - 1: DC Circuits

[08]

Electrical circuit elements (R, L and C), Concept of active and passive elements, voltage and current sources, concept of linearity and linear network, unilateral and bilateral elements, Kirchhoff's laws, Loop and nodal methods of analysis, Star-delta transformation, Superposition theorem, Thevenin theorem, Norton theorem.

Module - 2: Steady- State Analysis of Single Phase AC Circuits

[10]

Representation of Sinusoidal waveforms – Average and effective values, Form and peak factors, Concept of phasors, phasor representation of sinusoidally varying voltage and current.

Analysis of single phase AC Circuits consisting of R, L, C, RL, RC, RLC combinations (Series and Parallel), Apparent, active & reactive power, Power factor, power factor improvement. Concept of Resonance in series & parallel circuits, bandwidth and quality factor.

Three phase balanced circuits, voltage and current relations in star and delta connections.

Module - 3 : Transformers

[08]

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Module -4 : Electrical machines

[08]

DC machines: Principle & Construction, Types, EMF equation of generator and torque equation of motor, applications of DC motors (simple numerical problems)

Three Phase Induction Motor: Principle & Construction, Types, Slip-torque characteristics, Applications (Numerical problems related to slip only)

Single Phase Induction motor: Principle of operation and introduction to methods of starting, applications.

Three Phase Synchronous Machines: Principle of operation of alternator and synchronous motor and their applications.

Module -5 : Electrical Installations

[06]

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Importance of earthing. Types of Batteries, Important characteristics for Batteries. Elementary calculations for energy consumption and savings, battery backup.

COURSE OUTCOMES

1. Apply the concepts of KVL/KCL and network theorems in solving DC circuits.
2. Analyze the steady state behavior of single phase and three phase AC electrical circuits.
3. Identify the application areas of a single phase two winding transformer as well as an auto transformer and calculate their efficiency. Also identify the connections of a three phase transformer.
4. Illustrate the working principles of induction motor, synchronous machine as well as DC machine and employ them in different area of applications.
5. Describe the components of low voltage electrical installations and perform elementary calculations for energy consumption.

Spoken Tutorial (MOOCs):

1. AC DC Circuit Analysis using NgSpice, Open Source Software (<http://spoken-tutorial.org>)

Text Books:

1. Ritu Sahdev, "Basic Electrical Engineering", Khanna Publishing House.
2. S. Singh, P.V. Prasad, "Electrical Engineering: Concepts and Applications" Cengage.
3. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill.
4. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill.

Reference Books:

1. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
2. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press.
3. V. D. Toro, "Electrical Engineering Fundamentals", Pearson India.

ELECTRICAL ENGINEERING LABORATORY

LIST OF EXPERIMENTS

Note: A minimum of ten experiments from the following should be performed.

1. Verification of Kirchhoff's laws
2. Verification of Superposition and Thevenin Theorem.
3. Measurement of power and power factor in a single phase ac series inductive circuit and study improvement of power factor using capacitor
4. Study of phenomenon of resonance in RLC series circuit and obtain resonant frequency.
5. Connection and measurement of power consumption of a fluorescent lamp (tube light).
6. Measurement of power in 3- phase circuit by two wattmeter method and determination of its power factor for star as well as delta connected load.
7. Determination of parameters of ac single phase series RLC circuit
8. To observe the B-H loop of a ferromagnetic material in CRO.
9. Determination of (i) Voltage ratio (ii) polarity and (iii) efficiency by load test of a single phase transformer
10. Determination of efficiency of a dc shunt motor by load test
11. To study running and speed reversal of a three phase induction motor and record speed in both directions.
12. Demonstration of cut-out sections of machines: dc machine, three phase induction machine, single-phase induction machine and synchronous machine.

COURSE OUTCOMES

1. Conduct experiments illustrating the application of KVL/KCL and network theorems to DC electrical circuits.
2. Demonstrate the behavior of AC circuits connected to single phase AC supply and measure power in single phase as well as three phase electrical circuits.
3. Perform experiment illustrating BH curve of magnetic materials.
4. Calculate efficiency of a single phase transformer and DC machine.
5. Perform experiments on speed measurement and reversal of direction of three phase induction motor and Identify the type of DC and AC machines based on their construction.

Programming for Problem Solving

Module - 1 : (Introduction to Programming)

[08]

Introduction to components of a computer system: Memory, processor, I/O Devices, storage, operating system, Concept of assembler, compiler, interpreter, loader and linker.

Idea of Algorithm: Representation of Algorithm, Flowchart, Pseudo code with examples, From algorithms to programs, source code.

Programming Basics: Structure of C program, writing and executing the first C program, Syntax and logical errors in compilation, object and executable code. Components of C language. Standard I/O in C, Fundamental data types, Variables and memory locations, Storage classes.

Module - 2 : (Arithmetic expressions & Conditional Branching)

[08]

Arithmetic expressions and precedence: Operators and expression using numeric and relational operators, mixed operands, type conversion, logical operators, bit operations, assignment operator, operator precedence and associativity.

Conditional Branching: Applying if and switch statements, nesting if and else, use of break and default with switch.

Module - 3 : (Loops & Functions)

[08]

Iteration and loops: use of while, do while and for loops, multiple loop variables, use of break and continue statements.

Functions: Introduction, types of functions, functions with array, passing parameters to functions, call by value, call by reference, recursive functions.

Module - 4 : (Arrays & Basic Algorithms)

[08]

Arrays: Array notation and representation, manipulating array elements, using multi dimensional arrays. Character arrays and strings, Structure, union, enumerated data types, Array of structures, Passing arrays to functions.

Basic Algorithms: Searching & Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, Notion of order of complexity.

Module - 5 : (Pointer & File Handling)

[08]

Pointers: Introduction, declaration, applications, Introduction to dynamic memory allocation (malloc, calloc, realloc, free), Use of pointers in self-referential structures, notion of linked list (no implementation)

File handling:File I/O functions, Standard C preprocessors, defining and calling macros, command-line arguments.

COURSE OUTCOMES

1. To develop simple algorithms for arithmetic and logical problems.
2. To translate the algorithms to programs & execution (in C language).
3. To implement conditional branching, iteration and recursion.
4. To decompose a problem into functions and synthesize a complete program using divide and conquer approach.
5. To use arrays, pointers and structures to develop algorithms and programs.

Text books:

1. Schum"s Outline of Programming with C by Byron Gottfried, McGraw-Hill
2. The C programming by Kernighan Brain W. and Ritchie Dennis M., Pearson Education.
3. Computer Basics and C Programming by V.Rajaraman , PHI Learning Pvt. Limited, 2015.
4. Computer Concepts and Programming in C, R.S. Salaria, Khanna Publishing House
5. Computer Concepts and Programming in C, E Balaguruswami, McGraw Hill
6. Computer Science- A Structured Programming Approach Using C, by Behrouz A. Forouzan, Richard F. Gilberg, Thomson, Third Edition , Cengage Learning - 2007.
7. Let Us C By Yashwant P. Kanetkar.
8. Problem Solving and Program Design in C, by Jeri R. Hanly, Elliot B. Koffman, Pearson Addison-Wesley, 2006.
9. Programming in C by Kochan Stephen G. Pearson Education – 2015.
10. Computer Concepts and Programming in C by D.S. Yadav and Rajeev Khanna, New AgeInternational Publication.
11. Computer Concepts and Programming by Anami, Angadi and Manvi, PHI Publication.
12. Computer Concepts and Programming in C by Vikas Gupta, Wiley India Publication
13. Computer Fundamentals and Programming in C. Reema Thareja, Oxford Publication
14. Problem Solving and Programming in C, R.S. Salaria, Khanna Publishing House

Programming for Problem Solving Lab

Other Reference: -

1. Use C Open Source Software referring Spoken Tutorial MOOC

1. WAP that accepts the marks of 5 subjects and finds the sum and percentage marks obtained by the student.
2. WAP that calculates the Simple Interest and Compound Interest. The Principal, Amount, Rate of Interest and Time are entered through the keyboard.
3. WAP to calculate the area and circumference of a circle.
4. WAP that accepts the temperature in Centigrade and converts into Fahrenheit using the formula $C/5 = (F-32)/9$.
5. WAP that swaps values of two variables using a third variable.
6. WAP that checks whether the two numbers entered by the user are equal or not.
7. WAP to find the greatest of three numbers.
8. WAP that finds whether a given number is even or odd.
9. WAP that tells whether a given year is a leap year or not.
10. WAP that accepts marks of five subjects and finds percentage and prints grades according to the following criteria:
Between 90-100%-----Print „A”
80-90%----- Print „B”
60-80%-----Print „C”
Below 60%-----Print „D”
11. WAP that takes two operands and one operator from the user and perform the operation and prints the result by using Switch statement.
12. WAP to print the sum of all numbers up to a given number.
13. WAP to find the factorial of a given number.
14. WAP to print sum of even and odd numbers from 1 to N numbers.
15. WAP to print the Fibonacci series.
16. WAP to check whether the entered number is prime or not.
17. WAP to find the sum of digits of the entered number.
18. WAP to find the reverse of a number.
19. WAP to print Armstrong numbers from 1 to 100.
20. WAP to convert binary number into decimal number and vice versa.

21. WAP that simply takes elements of the array from the user and finds the sum of these elements.
22. WAP that inputs two arrays and saves sum of corresponding elements of these arrays in a third array and prints them.
23. WAP to find the minimum and maximum element of the array.
24. WAP to search an element in a array using Linear Search.
25. WAP to sort the elements of the array in ascending order using Bubble Sort technique.
26. WAP to add and multiply two matrices of order nxn.
27. WAP that finds the sum of diagonal elements of a mxn matrix.
28. WAP to implement strlen (), strcat (),strcpy () using the concept of Functions.
29. Define a structure data type TRAIN_INFO. The type contain Train No.: integer type Train name: string Departure Time: aggregate type TIME Arrival Time: aggregate type TIME Start station: string End station: string The structure type Time contains two integer members: hour and minute. Maintain a train timetable and implement the following operations:
 - (i) List all the trains (sorted according to train number) that depart from a particular section.
 - (ii) List all the trains that depart from a particular station at a particular time.
 - (iii) List all he trains that depart from a particular station within the next one hour of a given time.
 - (iv) List all the trains between a pair of start station and end station.
30. WAP to swap two elements using the concept of pointers.
31. WAP to compare the contents of two files and determine whether they are same or not.
32. WAP to check whether a given word exists in a file or not. If yes then find the number of times it occurs.

COURSE OUTCOMES

1. To write programs for arithmetic and logical problems.
2. To translate the algorithms to programs & execution (in C language).
3. To write programs for conditional branching, iteration and recursion.
4. To write programs using functions and synthesize a complete program using divide and conquer approach.
5. Write programs using arrays, pointers and structures.

Engineering Graphics and Design

Module 1: Introduction to Engineering Drawing, Orthographic Projections

[08]

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Scales – Plain and Diagonal Scales

Principles of Orthographic Projections – Conventions – Projections of Points and Lines inclined to both planes; Projections of planes inclined Planes – Auxiliary Planes.

Module 2: Projections and Sections of Regular Solids

[08]

Sections in lined to both the Planes – Auxiliary Views; Simple annotation, dimensioning and scale. Floor plans the include: windows, doors and fixtures such as WC, Bath, sink, shower, etc.

Prism, Cylinder, Pyramid, Cone – Auxiliary Vies: Development of surfaces of Right Regular Solids – Prism, Pyramid, Cylinder and Cone.

Module 3: Isometric Projections

[08]

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conversions.

Module 4: Computer Graphics

[08]

Listing the computer technologies the impact on graphical communication, Demonstration knowledge of the theory of CAD software [such as: The Menu System, Tollbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects: Isometric Views of lines, Planes, Simple and compound Solids];

Set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles:

Applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to pater using the print command: orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modelling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, Multiview, auxiliary, and section views. Spatial visualization exercises Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling:

Module 5: Demonstration of a simple team design project

[08]

Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modelling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).

Course Outcomes

- 1: Understanding of the visual aspects of engineering design
- 2: Understanding of engineering graphics standards and solid modelling
- 3: Effective communication through graphics
- 4: Applying modern engineering tools necessary for engineering practice
- 5: Applying computer-aided geometric design
- 6: Analysis of Isometric views
- 7: Creating working drawings

Suggested Text/ Reference Books:

- (i) Bhatt N.D., Panchal V.M. & Ingle P.R. (2014), Engineering Drawing, Charotar Publishing House.
- (ii) Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
- (iii) Agrawal B. & Agrawal C.M. (2012), Engineering Graphics, TMH Publication
- (iv) Engineering Graphics & Design, A.P. Gautam & Pradeep Jain, Khanna Publishing House
- (v) Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.
- (vi) (Corresponding set of) CAD Software Theory and User Manuals.

WORKSHOP PRACTICE

LIST OF EXPERIMENTS

Machine shop:

- Study of machine tools in particular Lathe machine
- Demonstration of different operations on Lathe machine
- Practice of Facing, Plane Turning, step turning, taper turning, knurling and parting.
- Study of Quick return mechanism of Shaper.

Fitting shop:

- Preparation of T-Shape Work piece as per the given specifications.
- Preparation of U-Shape Work piece which contains: Filing, Sawing, Drilling, Grinding.
- Practice marking operations.

Carpentry:

- Study of Carpentry Tools, Equipment and different joints.
- Practice of Cross Half lap joint, Half lap Dovetail joint and Mortise Tenon Joint

Electrical & Electronics

- Introduction to House wiring, different types of cables. Types of power supply, types of motors, Starters, distribution of power supply, types of bulbs, parts of tube light, Electrical wiring symbols.
- Soldering and desoldering of Resistor in PCB.
- Soldering and desoldering of IC in PCB.
- Soldering and desoldering of Capacitor in PCB

Welding:

- Instruction of BI standards and reading of welding drawings.
- Butt Joint
- Lap Joint
- TIG Welding
- MIG Welding

Casting:

- introduction to casting processes

Smithy

- Sharpening any arc and edge.
- Preparing small arc and edge,
- Repair of agricultural implements and power plough, use of power hammer etc.

Plastic Moulding & Glass Cutting

- Introduction to Patterns, pattern allowances, ingredients of moulding sand and melting furnaces.
Foundry tools and their purposes
- Demo of mould preparation
- Practice – Preparation of mould
- Glass cutting

COURSE OUTCOMES

1. Understanding and practice on machine tools and their operations
2. Practice on manufacturing of components using workshop trades including fitting, carpentry, foundry and welding
3. Identify and apply suitable tools for machining processes including turning, facing, thread cutting and tapping
4. Application of Welding and soldering operations
5. Understand use of basic electrical engineering knowledge for house wiring practice

Text Books:

1. Raghuwanshi B.S., Workshop Technology Vol. I & II, Dhanpath Rai & Sons.
2. Kannaiah P. and Narayana K.L., Workshop Manual, 2nd Edn, Scitech publishers.
3. John K.C., Mechanical Workshop Practice. 2nd Edn. PHI 2010.
4. Jeyapoovan T. and Pranitha S., Engineering Practices Lab Manual, 3rd Edn. Vikas Pub. 2008.

SEMESTER - II

PHYSICS

Module - 1 Relativistic Mechanics:

[8]

Frame of reference, Inertial & non-inertial frames, Galilean transformations, Michelson-Morley experiment, Postulates of special theory of relativity, Lorentz transformations, Length contraction, Time dilation, Velocity addition theorem, Variation of mass with velocity, Einstein's mass energy relation, Relativistic relation between energy and momentum, Massless particle.

Module- 2 Electromagnetic Field Theory:

[8]

Continuity equation for current density, Displacement current, Modifying equation for the curl of magnetic field to satisfy continuity equation, Maxwell's equations in vacuum and in non-conducting medium, Energy in an electromagnetic field, Poynting vector and Poynting theorem, Plane electromagnetic waves in vacuum and their transverse nature. Relation between electric and magnetic fields of an electromagnetic wave, Energy and momentum carried by electromagnetic waves, Resultant pressure, Skin depth.

Module- 3 Quantum Mechanics:

[8]

Black body radiation, Stefan's law, Wien's law, Rayleigh-Jeans law and Planck's law, Wave particle duality, Matter waves, Time-dependent and time-independent Schrodinger wave equation, Born interpretation of wave function, Solution to stationary state Schrodinger wave equation for one-dimensional particle in a box, Compton effect.

Module- 4 Wave Optics:

[10]

Coherent sources, Interference in uniform and wedge shaped thin films, Necessity of extended sources, Newton's Rings and its applications. Fraunhofer diffraction at single slit and at double slit, Absent spectra, Diffraction grating, Spectra with grating, Dispersive power, Resolving power of grating, Rayleigh's criterion of resolution, Resolving power of grating.

Module- 5 Fibre Optics & Laser:

[10]

Fibre Optics: Introduction to fibre optics, Acceptance angle, Numerical aperture, Normalized frequency, Classification of fibre, Attenuation and Dispersion in optical fibres.

Laser: Absorption of radiation, Spontaneous and stimulated emission of radiation, Einstein's coefficients, Population inversion, Various levels of Laser, Ruby Laser, He-Ne Laser, Laser applications.

Course Outcomes:

1. To solve the classical and wave mechanics problems
2. To develop the understanding of laws of thermodynamics and their application in various processes
3. To formulate and solve the engineering problems on Electromagnetism & Electromagnetic Field Theory
4. To aware of limits of classical physics & to apply the ideas in solving the problems in their parent streams

Reference Books:

1. Concepts of Modern Physics - AurthurBeiser (Mc-Graw Hill)
2. Introduction to Special Theory of Relativity- Robert Resnick (Wiley)
3. Optics - Brijlal& Subramanian (S. Chand)
4. Engineering Physics: Theory and Practical- Katiyar and Pandey (Wiley India)
5. Applied Physics for Engineers- Neeraj Mehta (PHI Learning, New)
6. Engineering Physics-Malik HK and Singh AK (McGrawHill)

PHYSICS LAB

List of Experiments (Any ten experiments (at least four from each group)).

Group A

1. To determine the wavelength of sodium light by Newton's ring experiment.
2. To determine the wavelength of different spectral lines of mercury light using plane transmission grating.
3. To determine the specific rotation of cane sugar solution using polarimeter.
4. To determine the focal length of the combination of two lenses separated by a distance and verify the formula for the focal length of combination of lenses.
5. To measure attenuation in an optical fiber.
6. To determine the wavelength of He-Ne laser light using single slit diffraction.
7. To study the polarization of light using He-Ne laser light.
8. To determine the wavelength of sodium light with the help of Fresnel's bi-prism.
9. To determine the coefficient of viscosity of a given liquid.
10. To determine the value of acceleration due to gravity (g) using compound pendulum.

Group B

11. To determine the energy band gap of a given semiconductor material.
12. To study Hall effect and determine Hall coefficient, carrier density and mobility of a given semiconductor material using Hall effect setup.
13. To determine the variation of magnetic field with the distance along the axis of a current carrying coil and estimate the radius of the coil.
14. To verify Stefan's law by electric method.
15. To determine resistance per unit length and specific resistance of a given resistance using Carey Foster's Bridge.
16. To study the resonance condition of a series LCR circuit.
17. To determine the electrochemical equivalent (ECE) of copper.
18. To calibrate the given ammeter and voltmeter by potentiometer.
19. To draw hysteresis (B-H curve) of a specimen in the form of a transformer and to determine its hysteresis loss.
20. To measure high resistance by leakage method.

Course Outcomes:

1. To determine the wavelength of sodium light by Newton's ring experiment
2. To determine the wavelength of sodium light with the help of Fresnel's bi-prism
3. To determine the variation of magnetic field with the distance along the axis of a current carrying coil and estimate the radius of the coil.
4. To draw hysteresis (B-H curve) of a specimen in the form of a transformer and to determine its hysteresis loss.

Reference Books

1. Practical Physics- K. K. Dey & B. N. Dutta (Kalyani Publishers New Delhi)
2. Engineering Physics-Theory and Practical- Katiyar& Pandey (Wiley India)
3. Engineering Physics Practical- S K Gupta (KrishnaPrakashan Meerut)

CHEMISTRY

Module-1

[08]

Atomic and Molecular Structure:

Molecular orbital's of diatomic molecules. Band theory of solids. Liquid crystal and its applications. Point defects in solids. Structure and applications of Graphite and Fullerenes. Concepts of Nanomaterials and its application.

Module-2

[08]

Spectroscopic techniques and Applications:

Elementary idea and simple applications of Rotational, Vibrational, Ultraviolet& Visible and Raman spectroscopy.

Module-3

[08]

Electrochemistry

Nernst Equation and application, relation of EMF with thermodynamic functions (ΔH , ΔF and ΔS). Lead storage battery.

Corrosion; causes, effects and its prevention.

Phase Rule and its application to water system.

Module-4

[08]

Water Analysis; Hardness of water, Techniques for water softening (Lime-soda, Zeolite, Ion exchange resin and Reverse osmosis method).

Fuels: classification of fuels, Analysis of coal, Determination of calorific value (Bomb calorimeter and Dulong's method).

Module-5

[08]

Polymer; Basic concepts of polymer-Blend and composites, Conducting and biodegradable polymers. Preparation and application of some industrially important polymers (Buna-S, Buna-N, Neoprene, Nylon-6, nylon-6,6 and Terylene). General methods of synthesis of organometallic compounds (Grignard reagent) and their applications.

Course Outcomes:

1. Get an understanding of the theoretical principles understanding molecular structure, bonding and properties.
2. Know the fundamental concepts of determination of structure with various techniques.
3. Know the fundamental concepts of chemistry applicable in industrial processes.

Reference Books:

1. University Chemistry By B.H. Mahan
2. University Chemistry By C.N.R. Rao
3. Organic Chemistry By I.L. Finar
4. Physical Chemistry By S. Glasstone
5. Engineering Chemistry By S.S. Dara
7. Polymer Chemistry By Fre W., Billmeyer
8. Engineering Chemistry By Satya Prakash

CHEMISTRY- PRACTICAL

LIST OF EXPERIMENTS

1. Determination of alkalinity in the given water sample.
2. Determination of temporary and permanent hardness in water sample using EDTA.
3. Determination of iron content in the given solution by Mohr's method.
4. Determination of viscosity of given liquid.
5. Determination of surface tension of given liquid.
6. Determination of chloride content in water sample.
7. Determination of available chlorine in bleaching powder.
8. Determination of pH by pH-metric titration.
9. Preparation of Phenol-formaldehyde and Urea-formaldehyde resin.
10. Determination of Cell constant and conductance of a solution.
11. Determination of rate constant of hydrolysis of esters.
12. Verification of Beer's law.

NOTE: Choice of any 10 experiments from the above. Institute can change any 02 experiments from the aforesaid experiments.

Course Outcomes:

1. Use of different analytical instruments.
2. Measure molecular/system properties such as surface tension, viscosity, conductance of solution, chloride and iron content in water.
3. Measure hardness of water.
4. Estimate the rate constant of reaction.

MATHEMATICS-II

(Common to all B. Tech. Courses)

Module 1: Ordinary Differential Equation of Higher Order

[10]

Linear differential equation of n^{th} order with constant coefficients, Simultaneous linear differential equations, Second order linear differential equations with variable coefficients, Solution by changing independent variable, Reduction of order, Normal form, Method of variation of parameters, Cauchy-Euler equation, Series solutions (Frobenius Method).

Module 2: Multivariable Calculus-II

[08]

Improper integrals, Beta & Gamma function and their properties, Dirichlet's integral and its applications, Application of definite integrals to evaluate surface areas and volume of revolutions.

Module 3: Sequences and Series

[08]

Definition of Sequence and series with examples, Convergence of sequence and series, Tests for convergence of series, (Ratio test, D'Alembert's test, Raabe's test). Fourier series, Half range Fourier sine and cosine series.

Module 4: Complex Variable – Differentiation

[08]

Limit, Continuity and differentiability, Functions of complex variable, Analytic functions, Cauchy- Riemann equations (Cartesian and Polar form), Harmonic function, Method to find Analytic functions, Conformal mapping, Mobius transformation and their properties

Module 5: Complex Variable –Integration

[08]

Complex integrals, Contour integrals, Cauchy- Goursat theorem, Cauchy integral formula, Taylor's series, Laurent's series, Liouville's theorem, Singularities, Classification of Singularities, zeros of analytic functions, Residues, Methods of finding residues, Cauchy Residue theorem, Evaluation of real integrals of the type Integral

$$\int_0^{2\pi} f(\cos \theta, \sin \theta) d\theta$$

COURSE OUTCOMES

1. Understand the concept of differentiation and apply for solving differential equations.
2. Remember the concept of definite integral and apply for evaluating surface areas and volumes.
3. Understand the concept of convergence of sequence and series. Also evaluate Fourier series
4. Illustrate the working methods of complex functions and apply for finding analytic functions.

5. Apply the complex functions for finding Taylor's series, Laurent's series and evaluation of definite integrals.

Text Books:-

1. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill Publishing Company Ltd., 2008.
2. B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.
3. R. K. Jain & S. R. K. Iyenger, Advance Engineering Mathematics, Narosa Publishing -House, 2002.

Reference Books:-

1. E. Kreyszig, Advance Engineering Mathematics, John Wiley & Sons, 2005.
2. Peter V. O'Neil, Advance Engineering Mathematics, Thomson (Cengage) Learning, 2007.
3. Maurice D. Weir, Joel Hass, Frank R. Giordano, Thomas, Calculus, Eleventh Edition, Pearson.
4. G.B Thomas, R L Finney, Calculus and Analytical Geometry, Ninth Edition Pearson, 2002.
5. James Ward Brown and Ruel V Churchill, Fourier Series and Boundary Value Problems, 8th Edition-Tata McGraw-Hill
6. D. Poole, Linear Algebra : A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
7. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
8. Charles E Roberts Jr, Ordinary Diffrential Equations, Application, Model and Computing, CRC Press T&F Group.
9. Ray Wylie C and Louis C Barret, Advanced Engineering Mathematics, 6th Edition, Tata McGraw-Hill.
10. James Ward Brown and Ruel V Churchill, Complex Variable and Applications, 8th Edition, Tata McGraw-Hill.
11. P. Sivaramakrishna Das and C. Vijayakumari, Engineering Mathematics, 1st Edition, Pearson India Education Services Pvt. Ltd.
12. Advanced Engineering Mathematics By Chandrika Prasad, Reena Garg Khanna Publishing House, Delhi

BASIC ELECTRICAL ENGINEERING

Module - 1: DC Circuits

[08]

Electrical circuit elements (R, L and C), Concept of active and passive elements, voltage and current sources, concept of linearity and linear network, unilateral and bilateral elements, Kirchhoff's laws, Loop and nodal methods of analysis, Star-delta transformation, Superposition theorem, Thevenin theorem, Norton theorem.

Module - 2: Steady- State Analysis of Single Phase AC Circuits

[10]

Representation of Sinusoidal waveforms – Average and effective values, Form and peak factors, Concept of phasors, phasor representation of sinusoidally varying voltage and current.

Analysis of single phase AC Circuits consisting of R, L, C, RL, RC, RLC combinations (Series and Parallel), Apparent, active & reactive power, Power factor, power factor improvement. Concept of Resonance in series & parallel circuits, bandwidth and quality factor.

Three phase balanced circuits, voltage and current relations in star and delta connections.

Module - 3 : Transformers

[08]

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Module -4 : Electrical machines

[08]

DC machines: Principle & Construction, Types, EMF equation of generator and torque equation of motor, applications of DC motors (simple numerical problems)

Three Phase Induction Motor: Principle & Construction, Types, Slip-torque characteristics, Applications (Numerical problems related to slip only)

Single Phase Induction motor: Principle of operation and introduction to methods of starting, applications.

Three Phase Synchronous Machines: Principle of operation of alternator and synchronous motor and their applications.

Module -5 : Electrical Installations

[06]

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Importance of earthing. Types of Batteries, Important characteristics for Batteries. Elementary calculations for energy consumption and savings, battery backup.

COURSE OUTCOMES

1. Apply the concepts of KVL/KCL and network theorems in solving DC circuits.
2. Analyze the steady state behavior of single phase and three phase AC electrical circuits.
3. Identify the application areas of a single phase two winding transformer as well as an auto transformer and calculate their efficiency. Also identify the connections of a three phase transformer.
4. Illustrate the working principles of induction motor, synchronous machine as well as DC machine and employ them in different area of applications.
5. Describe the components of low voltage electrical installations and perform elementary calculations for energy consumption.

Spoken Tutorial (MOOCs):

1. AC DC Circuit Analysis using NgSpice, Open Source Software (<http://spoken-tutorial.org>)

Text Books:

1. Ritu Sahdev, "Basic Electrical Engineering", Khanna Publishing House.
2. S. Singh, P.V. Prasad, "Electrical Engineering: Concepts and Applications" Cengage.
3. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill.
4. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill.

Reference Books:

1. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
2. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press.
3. V. D. Toro, "Electrical Engineering Fundamentals", Pearson India.

ELECTRICAL ENGINEERING LABORATORY

LIST OF EXPERIMENTS

Note: A minimum of ten experiments from the following should be performed.

1. Verification of Kirchhoff's laws
2. Verification of Superposition and Thevenin Theorem.
3. Measurement of power and power factor in a single phase ac series inductive circuit and study improvement of power factor using capacitor
4. Study of phenomenon of resonance in RLC series circuit and obtain resonant frequency.
5. Connection and measurement of power consumption of a fluorescent lamp (tube light).
6. Measurement of power in 3- phase circuit by two wattmeter method and determination of its power factor for star as well as delta connected load.
7. Determination of parameters of ac single phase series RLC circuit
8. To observe the B-H loop of a ferromagnetic material in CRO.
9. Determination of (i) Voltage ratio (ii) polarity and (iii) efficiency by load test of a single phase transformer
10. Determination of efficiency of a dc shunt motor by load test
11. To study running and speed reversal of a three phase induction motor and record speed in both directions.
12. Demonstration of cut-out sections of machines: dc machine, three phase induction machine, single-phase induction machine and synchronous machine.

COURSE OUTCOMES

1. Conduct experiments illustrating the application of KVL/KCL and network theorems to DC electrical circuits.
2. Demonstrate the behavior of AC circuits connected to single phase AC supply and measure power in single phase as well as three phase electrical circuits.
3. Perform experiment illustrating BH curve of magnetic materials.
4. Calculate efficiency of a single phase transformer and DC machine.
5. Perform experiments on speed measurement and reversal of direction of three phase induction motor and Identify the type of DC and AC machines based on their construction.

Programming for Problem Solving

Module - 1 : (Introduction to Programming)

[08]

Introduction to components of a computer system: Memory, processor, I/O Devices, storage, operating system, Concept of assembler, compiler, interpreter, loader and linker.

Idea of Algorithm: Representation of Algorithm, Flowchart, Pseudo code with examples, From algorithms to programs, source code.

Programming Basics: Structure of C program, writing and executing the first C program, Syntax and logical errors in compilation, object and executable code. Components of C language. Standard I/O in C, Fundamental data types, Variables and memory locations, Storage classes.

Module - 2 : (Arithmetic expressions & Conditional Branching)

[08]

Arithmetic expressions and precedence: Operators and expression using numeric and relational operators, mixed operands, type conversion, logical operators, bit operations, assignment operator, operator precedence and associativity.

Conditional Branching: Applying if and switch statements, nesting if and else, use of break and default with switch.

Module - 3 : (Loops & Functions)

[08]

Iteration and loops: use of while, do while and for loops, multiple loop variables, use of break and continue statements.

Functions: Introduction, types of functions, functions with array, passing parameters to functions, call by value, call by reference, recursive functions.

Module - 4 : (Arrays & Basic Algorithms)

[08]

Arrays: Array notation and representation, manipulating array elements, using multi-dimensional arrays. Character arrays and strings, Structure, union, enumerated data types, Array of structures, passing arrays to functions.

Basic Algorithms: Searching & Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, Notion of order of complexity.

Module - 5 : (Pointer & File Handling)

[08]

Pointers: Introduction, declaration, applications, Introduction to dynamic memory allocation (malloc, calloc, realloc, free), Use of pointers in self-referential structures, notion of linked list (no implementation)

File handling:File I/O functions, Standard C preprocessors, defining and calling macros, command-line arguments.

COURSE OUTCOMES

1. To develop simple algorithms for arithmetic and logical problems.
2. To translate the algorithms to programs & execution (in C language).
3. To implement conditional branching, iteration and recursion.
4. To decompose a problem into functions and synthesize a complete program using divide and conquer approach.
5. To use arrays, pointers and structures to develop algorithms and programs.

Text books:

1. Schum"s Outline of Programming with C by Byron Gottfried, McGraw-Hill
2. The C programming by Kernighan Brain W. and Ritchie Dennis M., Pearson Education.
3. Computer Basics and C Programming by V.Rajaraman , PHI Learning Pvt. Limited, 2015.
4. Computer Concepts and Programming in C, R.S. Salaria, Khanna Publishing House
5. Computer Concepts and Programming in C, E Balaguruswami, McGraw Hill
6. Computer Science- A Structured Programming Approach Using C, by Behrouz A. Forouzan, Richard F. Gilberg, Thomson, Third Edition , Cengage Learning - 2007.
7. Let Us C By Yashwant P. Kanetkar.
8. Problem Solving and Program Design in C, by Jeri R. Hanly, Elliot B. Koffman, Pearson Addison-Wesley, 2006.
9. Programming in C by Kochan Stephen G. Pearson Education – 2015.
10. Computer Concepts and Programming in C by D.S. Yadav and Rajeev Khanna, New AgeInternational Publication.
11. Computer Concepts and Programming by Anami, Angadi and Manvi, PHI Publication.
12. Computer Concepts and Programming in C by Vikas Gupta, Wiley India Publication
13. Computer Fundamentals and Programming in C. Reema Thareja, Oxford Publication
14. Problem Solving and Programming in C, R.S. Salaria, Khanna Publishing House

Programming for Problem Solving Lab

Other Reference: -

1. Use C Open Source Software referring Spoken Tutorial MOOC

1. WAP that accepts the marks of 5 subjects and finds the sum and percentage marks obtained by the student.
2. WAP that calculates the Simple Interest and Compound Interest. The Principal, Amount, Rate of Interest and Time are entered through the keyboard.
3. WAP to calculate the area and circumference of a circle.
4. WAP that accepts the temperature in Centigrade and converts into Fahrenheit using the formula $C/5 = (F-32)/9$.
5. WAP that swaps values of two variables using a third variable.
6. WAP that checks whether the two numbers entered by the user are equal or not.
7. WAP to find the greatest of three numbers.
8. WAP that finds whether a given number is even or odd.
9. WAP that tells whether a given year is a leap year or not.
10. WAP that accepts marks of five subjects and finds percentage and prints grades according to the following criteria:
Between 90-100%-----Print „A“
80-90%----- Print „B“
60-80%----- Print „C“
Below 60%----- Print „D“
11. WAP that takes two operands and one operator from the user and perform the operation and prints the result by using Switch statement.
12. WAP to print the sum of all numbers up to a given number.
13. WAP to find the factorial of a given number.
14. WAP to print sum of even and odd numbers from 1 to N numbers.
15. WAP to print the Fibonacci series.
16. WAP to check whether the entered number is prime or not.
17. WAP to find the sum of digits of the entered number.
18. WAP to find the reverse of a number.
19. WAP to print Armstrong numbers from 1 to 100.
20. WAP to convert binary number into decimal number and vice versa.
21. WAP that simply takes elements of the array from the user and finds the sum of these elements.
22. WAP that inputs two arrays and saves sum of corresponding elements of these arrays in a third array and prints them.

23. WAP to find the minimum and maximum element of the array.
24. WAP to search an element in a array using Linear Search.
25. WAP to sort the elements of the array in ascending order using Bubble Sort technique.
26. WAP to add and multiply two matrices of order nxn.
27. WAP that finds the sum of diagonal elements of a mxn matrix.
28. WAP to implement strlen (), strcat (),strcpy () using the concept of Functions.
29. Define a structure data type TRAIN_INFO. The type contain Train No.: integer type Train name: string Departure Time: aggregate type TIME Arrival Time: aggregate type TIME Start station: string End station: string The structure type Time contains two integer members: hour and minute. Maintain a train timetable and implement the following operations:
 - (i) List all the trains (sorted according to train number) that depart from a particular section.
 - (ii) List all the trains that depart from a particular station at a particular time.
 - (iii) List all he trains that depart from a particular station within the next one hour of a given time.
 - (iv) List all the trains between a pair of start station and end station.
30. WAP to swap two elements using the concept of pointers.
31. WAP to compare the contents of two files and determine whether they are same or not.
32. WAP to check whether a given word exists in a file or not. If yes then find the number of times it occurs.

COURSE OUTCOMES

1. To write programs for arithmetic and logical problems.
2. To translate the algorithms to programs & execution (in C language).
3. To write programs for conditional branching, iteration and recursion.
4. To write programs using functions and synthesize a complete program using divide and conquer approach.
5. write programs using arrays, pointers and structures.

Engineering Graphics and Design

Module 1: Introduction to Engineering Drawing, Orthographic Projections

[08]

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Scales – Plain and Diagonal Scales

Principles of Orthographic Projections – Conventions – Projections of Points and Lines inclined to both planes; Projections of planes inclined Planes – Auxiliary Planes.

Module 2: Projections and Sections of Regular Solids

[08]

Sections in lined to both the Planes – Auxiliary Views; Simple annotation, dimensioning and scale. Floor plans the include: windows, doors and fixtures such as WC, Both, sink, shower, etc.

Prism, Cylinder, Pyramid, Cone – Auxiliary Vies: Development of surfaces of Right Regular Solids – Prism, Pyramid, Cylinder and Cone.

Module 3: Isometric Projections

[08]

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conversions.

Module 4: Computer Graphics

[08]

Listing the computer technologies the impact on graphical communication, Demonstration knowledge of the theory of CAD software [such as: The Menu System, Tollbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects: Isometric Views of lines, Planes, Simple and compound Solids];

Set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles:

Applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to pater using the print command: orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modelling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, Multi view, auxiliary, and section views. Spatial visualization exercises Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling:

Module 5: Demonstration of a simple team design project

[08]

Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modelling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).

Course Outcomes

- 1: Understanding of the visual aspects of engineering design
- 2: Understanding of engineering graphics standards and solid modelling
- 3: Effective communication through graphics
- 4: Applying modern engineering tools necessary for engineering practice
- 5: Applying computer-aided geometric design
- 6: Analysis of Isometric views
- 7: Creating working drawings

Suggested Text/ Reference Books:

- (i) Bhatt N.D., Panchal V.M. & Ingle P.R. (2014), Engineering Drawing, Charotar Publishing House.
- (ii) Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
- (iii) Agrawal B. & Agrawal C.M. (2012), Engineering Graphics, TMH Publication
- (iv) Engineering Graphics & Design, A.P. Gautam & Pradeep Jain Khanna Publishing House
- (v) Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.
- (vi) (Corresponding set of) CAD Software Theory and User Manuals.

WORKSHOP PRACTICE

LIST OF EXPERIMENTS

Machine shop:

- Study of machine tools in particular Lathe machine
- Demonstration of different operations on Lathe machine
- Practice of Facing, Plane Turning, step turning, taper turning, knurling and parting.
- Study of Quick return mechanism of Shaper.

Fitting shop:

- Preparation of T-Shape Work piece as per the given specifications.
- Preparation of U-Shape Work piece which contains: Filing, Sawing, Drilling, Grinding.
- Practice marking operations.

Carpentry:

- Study of Carpentry Tools, Equipment and different joints.
- Practice of Cross Half lap joint, Half lap Dovetail joint and Mortise Tenon Joint

Electrical & Electronics

- Introduction to House wiring, different types of cables. Types of power supply, types of motors, Starters, distribution of power supply, types of bulbs, parts of tube light, Electrical wiring symbols.
- Soldering and desoldering of Resistor in PCB.
- Soldering and desoldering of IC in PCB.
- Soldering and desoldering of Capacitor in PCB

Welding:

- Instruction of BI standards and reading of welding drawings.
- Butt Joint
- Lap Joint
- TIG Welding
- MIG Welding

Casting:

- introduction to casting processes

Smithy

- Sharpening any arc and edge.
- Preparing small arc and edge,
- Repair of agricultural implements and power plough, use of power hammer etc.

Plastic Moulding& Glass Cutting

- Introduction to Patterns, pattern allowances, ingredients of moulding sand and melting furnaces.
Foundry tools and their purposes
- Demo of mould preparation
- Practice – Preparation of mould
- Glass cutting

COURSE OUTCOMES

1. Understanding and practice on machine tools and their operations
2. Practice on manufacturing of components using workshop trades including fitting, carpentry, foundry and welding
3. Identify and apply suitable tools for machining processes including turning, facing, thread cutting and tapping
4. Application of Welding and soldering operations
5. Understand use of basic electrical engineering knowledge for house wiring practice

Text Books:

1. Raghuwanshi B.S., Workshop Technology Vol. I & II, Dhanpath Rai & Sons.
2. Kannaiah P. and Narayana K.L., Workshop Manual, 2nd Edn, Scitech publishers.
3. John K.C., Mechanical Workshop Practice. 2nd Edn. PHI 2010.
4. JeyapoovanT.and Pranitha S., Engineering Practices Lab Manual, 3rd Edn. Vikas Pub.2008.

PROFESSIONAL ENGLISH

Module 1- Basics of Technical English

[08]

Technical English: Definition; Extent & Coverage; Dimensions; Reading; Skimming; Scanning; Churning & Assimilation; Writing: Methods: Inductive; Deductive; Exposition; Linear; Interrupted; Spatial & Chronological etc; Technical Communication; Approaches: Brevity; Objectivity; Simplicity; Utility & Clarity. **Listening:** Active; Passive; Thinking strategies: Positive & Logical thinking; Speaking: Essentials Nuances & Modes of Speech Delivery.

Module 2- Components of Technical Writing

[08]

Vocabulary Building: Select words; Concept of word formation; Word formation; Root words from foreign languages & their use in English; Prefixes & Suffixes: Derivatives; Synonyms; Antonyms; Abbreviations. Homophones. One word substitutes; Requisites of Sentences.

Module 3- Basic Technical Writing Skills

[08]

Forms: Business writing: Principle; Purchase & Sales Letters; Drafts; Official Writing: Official Letter; D.O. Letter; Notices; Agenda; Minutes of Meeting; Sentence Structure; Phrases & Clauses in sentences; Coherence; Unity; Emphasis in Writing; Devices; Use of Writing methods in Documents; Techniques of writing.

Module 4- Common Grammatical Errors & Technical Style

[08]

Subject-verb agreement; Correct usage: Noun; Pronoun; Agreement; Modifiers; Articles; Prepositions; Cliches; Redundancies; Technical Style: Features; Choice of words; Sentences: Descriptive; Narrative; Expository; Defining & Classifying; Length of paragraph; Writing of Introduction & Conclusion.

Module 5- Presentation Strategies & Oral Communications

[08] Analysis of

locale; Audience; Modulating Style & Content; Speaking with confidence; Kinesics; Paralinguistic features of Voice-Dynamics: Pitch; Intonation; Stress & Rhythm; Conversation & dialogues; Communication at work-place; etc.

COURSE OUTCOMES

1. Students will be enabled to **understand** the basic objective of the course by being acquainted with specific dimensions of communication skills i.e. Reading, Writing, Listening, Thinking and Speaking.
2. Students would be able to **create** substantial base by the formation of strong professional vocabulary for its application at different platforms and through numerous modes as Comprehension, reading, writing and speaking etc.
3. Students will **apply** it at their work place for writing purposes such as Presentation/official drafting/administrative communication and use it for document/project/report/research paper writing.

4. Students will be made to **evaluate** the correct & error-free writing by being well-versed in rules of English grammar & cultivate relevant technical style of communication & presentation at their work place & also for academic uses.

5. Students will **apply** it for practical and oral presentation purposes by being honed up in presentation skills and voice-dynamics. They will apply techniques for developing interpersonal communication skills and positive attitude leading to their professional competence.

Text Books:

1. Technical Communication – Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
2. Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, New Delhi.

Reference Books:

1. Word Power Made Easy by Norman Lewis, W.R. Goyal Pub. & Distributors, 2009, Delhi.
2. Manual of Practical Communication by L.U.B. Pandey; A.I.T.B.S. Publications India Ltd.; Krishan Nagar, 2013, Delhi.
3. English Grammar and Usage by R.P.Sinha, Oxford University Press, 2005, New Delhi.
4. English Grammar, Composition and Usage by N.K. Agrawal & F.T. Wood, Macmillan India Ltd., New Delhi.
5. Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House
6. English Grammar & Composition by Wren & Martin, S.Chand & Co. Ltd., New Delhi.
7. Communication Skills for Engineers and Scientists, Sangeeta Sharma et.al. PHI Learning Pvt. Ltd, 2011, New Delhi.
8. Personality Development, Harold R. Wallace & L. Ann Masters, Cengage Learning, New Delhi
9. Personality Development & Soft Skills, Barun K. Mitra, Oxford University Press, 2012 New Delhi.
10. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
11. Developing Communication Skills by Krishna Mohan, Meera Bannerji- Macmillan India Ltd. 1990, Delhi.
12. Spoken English- A manual of Speech and Phonetics by R.K. Bansal & J.B. Harrison, Orient Blackswan, 2013, New Delhi.
13. Business English by Ken Taylor, Orient Blackswan, 2011, New Delhi.

EVALUATION SCHEME & SYLLABUS

for

B. TECH

2nd Year

MECHANICAL ENGINEERING

as per AKTU and AICTE Model Curriculum

(Effective from Session: 2019-20)

w.e.f. session-2019-20

SEMESTER- III													
Sl. No.	Subject Codes	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1	KOE031-38/ KAS302	Engg. Science Course/Maths IV	3	1	0	30	20	50		100		150	4
2	KAS301/ KVE301	Technical Communication/Universal Human Values	2	1	0	30	20	50		100		150	3
			3	0	0								
3	KME301	Thermodynamics	3	1	0	30	20	50		100		150	4
4	KME302	Fluid Mechanics & Fluid Machines	3	1	0	30	20	50		100		150	4
5	KME303	Materials Engineering	3	0	0	30	20	50		100		150	3
6	KME351	Fluid Mechanics Lab	0	0	2				25		25	50	1
7	KME352	Material Testing Lab	0	0	2				25		25	50	1
8	KME353	Computer Aided Machine Drawing-I Lab	0	0	2				25		25	50	1
9	KME354	Mini Project or Internship Assessment*	0	0	2			50				50	1
10	KNC301/ KNC302	Computer System Security/Python Programming	2	0	0	15	10	25		50			0
11		MOOCs (Essential for Hons. Degree)											
		Total										950	22

*The Mini Project or internship (3-4 weeks) conducted during summer break after II semester and will be assessed during III semester.

SEMESTER- IV													
Sl. No.	Subject Codes	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1	KAS402/ KOE041-48	Maths IV/Engg. Science Course	3	1	0	30	20	50		100		150	4
2	KVE401/ KAS401	Universal Human Values/Technical Communication	3	0	0	30	20	50		100		150	3
			2	1	0								
3	KME401	Applied Thermodynamics	3	0	0	30	20	50		100		150	3
4	KME402	Engineering Mechanics	3	1	0	30	20	50		100		150	4
5	KME403	Manufacturing Processes	3	1	0	30	20	50		100		150	4
6	KME451	Applied Thermodynamics Lab	0	0	2				25		25	50	1
7	KME452	Manufacturing Processes Lab	0	0	2				25		25	50	1
8	KME453	Computer Aided Machine Drawing-II Lab	0	0	2				25		25	50	1
9	KNC402/ KNC401	Python Programming / Computer System Security	2	0	0	15	10	25		50			0
10		MOOCs (Essential for Hons. Degree)											
		Total										900	21

SEMESTER-III

KME 301 : THERMODYNAMICS

L-T-P
3-1-0

Objectives:

1. To learn about work and heat interactions, and balance of energy between system and its surroundings.
2. To learn about application of I law to various energy conversion devices.
3. To evaluate the changes in properties of substances in various processes.
4. To understand the difference between high grade and low-grade energies and II law limitations on energy conversion.

UNIT I

Review of Fundamental Concepts and Definitions:

Introduction- Basic Concepts: System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic view points, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & Inexact Differentials, Cycle Reversibility Quasi – static Process, Irreversible Process, Causes of Irreversibility Energy and its forms, Work and heat (sign convention), Gas laws, Ideal gas, Real gas, Law of corresponding states, Property of mixture of gases, electrical, magnetic, gravitational, spring and shaft work.

Zeroth law of thermodynamics: Concept of Temperature and its' measurement, Temperature scales.

First law of thermodynamics:

First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume. Limitations of first law of thermodynamics, PMM-I. Steady flow systems and their analysis, Steady flow energy equation, Boilers, Condensers, Turbine, Throttling process, Pumps etc.

UNIT II

Second law of thermodynamics:

Thermal reservoirs, Energy conversion, Heat engines, Efficiency, Reversed heat engine, Heat pump, Refrigerator, Coefficient of Performance, Kelvin Planck and Clausius statement of second law of thermodynamics, Equivalence of the two statements. Reversible and irreversible processes, Carnot cycle and Carnot engine, Carnot theorem and it's corollaries, Thermodynamic Temperature Scale, PMM-II.

Entropy: Clausius inequality, Concept of Entropy, Entropy change of pure substance in different thermodynamic processes, Tds equation, Principle of entropy increase, T-S diagram, Statement of the third law of thermodynamics.

UNIT III

Availability and Irreversibility:

Available and unavailable energy, Availability and Irreversibility, Second law efficiency, Helmholtz & Gibb's function.

Thermodynamic relations:

Conditions for exact differentials. Maxwell relations, Clapeyron equation, Joule-Thompson coefficient and Inversion curve. Coefficient of volume expansion, Adiabatic and Isothermal compressibility.

UNIT IV

Properties of steam and Rankine cycle:

Pure substance, Property of Pure Substance (steam), Triple point, Critical point, Saturation states, Sub-cooled liquid state, Superheated vapour state, Phase transformation process of water, Graphical representation of pressure, volume and temperature, P-T, P-V and P-h diagrams, T-S and H-S diagrams, use of property diagram, Steam-Tables & Moller chart, Dryness factor and it's measurement, processes involving steam in closed and open systems. Simple Rankine cycle.

Air-water vapour mixture and Psychrometry: Psychrometric terms and their definitions, Psychrometric chart, Different Psychrometric processes and their representation on Psychrometric chart.

UNIT V

Refrigeration Cycles:

Reversed Carnot Cycle for gas and vapour. Refrigeration capacity, unit of refrigeration. Air Refrigeration cycles; Reversed Brayton Cycle and Bell Coleman Cycle. Vapour compression refrigeration cycle; simple saturated cycle and actual vapour compression refrigeration cycle. Analysis of cycles, effect of superheating, sub-cooling and change in evaporator and condenser pressure on performance of vapour compression refrigeration cycle. Refrigerants; their classification and desirable properties. Vapour absorption refrigeration system.

Course Outcomes:

1. To understand and develop the capability of applying the fundamental concepts of basic thermodynamics
2. To evaluate and solve the applied problems of first and second law of thermodynamics
3. To evaluate and analyse the concept of entropy, availability and irreversibility

4. To apply the steam table for finding the different properties of steam and to explain the basic concept of IC engines
5. To apply and evaluate the numerical problems based on refrigeration

Books and References:

1. Basic and Applied Thermodynamics by PK Nag, MCGRAW HILL INDIA.
2. Thermodynamics for Engineers by Kroos& Potter, Cengage Learning.
3. Thermodynamics by Shavit and Gutfinger, CRC Press.
4. Thermodynamics- An Engineering Approach by Cengel, MCGRAW HILL INDIA.
5. Basic Engineering Thermodynamics, Joel, Pearson.
6. Fundamentals of Engineering Thermodynamics by Rathakrishnan, PHI.
7. Engineering Thermodynamics by Dhar, Elsevier.
8. Engineering Thermodynamics by Onkar Singh, New Age International.
9. Engineering Thermodynamics by CP Arora.
10. Engineering Thermodynamics by Rogers, Pearson.
11. Fundamentals of Engineering Thermodynamics by Moran, Shapiro, Boettner, & Bailey, John Wiley.
12. Engineering Thermodynamics by Mishra, Cengage Learning.
13. Refrigeration and Air Conditioning by C P Arora, MCGRAW HILL INDIA.

KME 302: FLUID MECHANICS AND FLUID MACHINES

L-T-P
3-1-0

Objectives:

1. To learn about the application of mass and momentum conservation laws for fluid flows.
2. To understand the importance of dimensional analysis.
3. To obtain the velocity and pressure variations in various types of simple flows.
4. To analyze the flow in water pumps and turbines.

UNIT-I

Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, Incompressible flow, Bernoulli's equation and its applications - Pitot tube, orifice meter, venturi meter and bend meter, notches and weirs, momentum equation and its application to pipe bends.

UNIT-II

Continuum & free molecular flows. Steady and unsteady, uniform and non-uniform, laminar and turbulent flows, rotational and irrotational flows, compressible and incompressible flows, subsonic, sonic and supersonic flows, sub-critical, critical and supercritical flows, one, two- and three-dimensional flows, streamlines, continuity equation for 3D and 1D flows, circulation, stream function and velocity potential. Buckingham's Pi theorem, important dimensionless numbers and their significance.

UNIT-III

Equation of motion for laminar flow through pipes, turbulent flow, isotropic, homogenous turbulence, scale and intensity of turbulence, measurement of turbulence, eddy viscosity, resistance to flow, minor losses, pipe in series and parallel, power transmission through a pipe, siphon, water hammer, three reservoir problems and pipe networks.

Boundary layer thickness, boundary layer over a flat plate, laminar boundary layer, application of momentum equation, turbulent boundary layer, laminar sublayer, separation and its control, Drag and lift, drag on a sphere, a two-dimensional cylinder, and an aerofoil, Magnus effect.

UNIT-IV

Introduction to hydrodynamic thrust of jet on a fixed and moving surface, Classification of turbines, Impulse turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Governing of Pelton wheel.

Francis and Kaplan turbines, Constructional details, Velocity triangles, Power and efficiency Principles of similarity, Unit and specific speed, Performance characteristics, Selection of water turbines.

UNIT-V

Classifications of centrifugal pumps, Vector diagram, Work done by impellor, Efficiencies of centrifugal pumps, Specific speed, Cavitation & separation, Performance characteristics. Reciprocating pump theory, Slip, Indicator diagram, Effect of acceleration, air vessels, Comparison of centrifugal and reciprocating pumps, Performance characteristics.

Course Outcomes:

1. Identify the importance of various fluid properties at rest and in transit.
2. Derive and apply general governing equations for various fluid flows.
3. Understand the concept of boundary layer theory and flow separation.
4. Plot velocity and pressure profiles for any given fluid flow.
5. Evaluate the performance characteristics of hydraulic turbines and pumps.

Books and References:

1. Introduction to fluid mechanics and Fluid machines by S.K Som, Gautam Biswas, S Chakraborty.
2. Fluid mechanics and machines by R.K Bansal.
3. F. M. White, Fluid Mechanics, 6th Ed., Tata McGraw-Hill, 2008.
4. Fluid Mechanics and Its Applications by V.K.Gupta et.al.
5. Fluid Mechanics by Yunus Cengel.
6. Batchelor, G. K. (1999). Introduction to fluid dynamics. New Delhi, India: Cambridge University Press.
7. Acheson, D. J. (1990). Elementary fluid dynamics. New York, USA: Oxford University Press.
8. R.W. Fox, A.T. McDonald and P.J. Pritchard, Introduction to Fluid Mechanics, 6th Ed., John Wiley, 2004.

KME 303: MATERIALS ENGINEERING

L-T-P
3-0-0

Objectives:

1. Understanding of the correlation between the internal structure of materials, their mechanical properties and various methods
2. To quantify their mechanical integrity and failure criteria.
3. To provide a detailed interpretation of equilibrium phase diagrams.
4. Learning about different phases and heat treatment methods to tailor the properties of Fe-C alloys.

UNIT-I

Crystal Structure:

Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress. Mechanical Property measurement: Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength.

UNIT-II

Static failure theories: Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Mohr-Coulomb and Modified Mohr-Coulomb; Fracture mechanics: Introduction to Stress-intensity factor approach and Griffith criterion. Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue, Introduction to non-destructive testing (NDT).

UNIT-III

Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron-iron-carbide phase diagram and microstructural aspects of ledeburite, austenite, ferrite and cementite, cast iron.

UNIT-IV

Heat treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties-austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening.

UNIT-V

Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based super alloys and Titanium alloys.

Course Outcomes:

- a. Student will be able to identify crystal structures for various materials and their properties and defects
- b. Students will be able to quantify mechanical integrity and failure in materials
- c. Ability to tailor material properties of ferrous and non-ferrous alloys using the Phase Diagram
- d. Ability to design the materials using heat treatment for obtaining the desired properties.
- e. Ability to understand the effect of alloying elements in ferrous and nonferrous metals and their alloys

Books and References:

1. Callister W. D., 2006, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley India.
2. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. Raghavan V., "Material Science and Engineering", Prentice Hall of India Private Limited, 1999.
4. James M. Gere "Mechanics of materials".
5. Agarwal B.K.. "Introduction to engineering materials"
6. Smallman R.E. "Physical metallurgy and advanced materials".
7. Daniel Isaac M "Engineering mechanics of composite materials".
8. Jindal U. C., "Engineering Materials and Metallurgy", Pearson, 2011.

KVE-301: HUMAN VALUES AND PROFESSIONAL ETHICS

L T P
3 0 0

Unit-I:- Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Understanding the need, basic guidelines, content and process for Value Education
2. Self Exploration—what is it? - its content and process; ‘Natural Acceptance’ and Experiential Validation- as the mechanism for self exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facilities- the basic requirements for fulfilment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels

Unit-II:- Understanding Harmony in the Human Being - Harmony in Myself! 7. Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’
8. Understanding the needs of Self (‘I’) and ‘Body’ - Sukh and Suvidha
9. Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer)
10. Understanding the characteristics and activities of ‘I’ and harmony in ‘I’
11. Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail
12. Programs to ensure Sanyam and Swasthya - Practice Exercises and Case Studies will be taken up in Practice Sessions.

Unit-III:- Understanding Harmony in the Family and Society- Harmony in Human Human Relationship
13. Understanding Harmony in the family – the basic unit of human interaction
14. Understanding values in human-human relationship; meaning of Nyaya and program for its fulfilment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship
15. Understanding the meaning of Vishwas; Difference between intention and competence
16. Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship
17. Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals
18. Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha)- from family to world family! - Practice Exercises and Case Studies will be taken up in Practice Sessions.

Unit-IV:- Understanding Harmony in the Nature and Existence - Whole existence as Co-existence
19. Understanding the harmony in the Nature
20. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature
21. Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space
22. Holistic perception of harmony at all levels of existence - Practice Exercises and Case Studies will be taken up in Practice Sessions.

Unit-V:- Implications of the above Holistic Understanding of Harmony on Professional Ethics
23. Natural acceptance of human values
24. Definitiveness of Ethical Human Conduct
25. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
26. Competence in professional ethics: a) Ability to utilize the professional competence for augmenting universal human order b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, c) Ability to identify and develop appropriate technologies and management patterns for above production systems.
27. Case studies of typical holistic technologies, management models and production systems
28. Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers b) At the level of society: as mutually enriching institutions and organizations

Course Outcome (CO)

1. Understand the relation between individual, society and the profession which in turn would help them become ethical and rational decision makers.
2. Understand their role and responsibility towards nature, fellow beings and society at large.
3. Learn and inculcate moral values and ethics in their personal as well as professional life.
4. Obtain a holistic approach in maintaining work life balance by right understanding of human relationships and human issues.
5. Distinguish between ethical and unethical practices and start working-out the strategy to actualize a harmonious environment where ever they work

KME 351: FLUID MECHANICS LAB

**L-T-P
0-0-2**

Objectives:

1. To understand the principles and performance characteristics of flow and thermal devices.
2. To know about the measurement of the fluid properties.

List of Experiments: (At least 8 of the following)

1. To determine the coefficient of impact for vanes.
2. To determine coefficient of discharge of an orifice meter.
3. To determine the coefficient of discharge of Notch (V and Rectangular types).
4. To determine the friction factor for the pipes.
5. To determine the coefficient of discharge of venturi meter.
6. To determine the coefficient of discharge, contraction & velocity of an orifice.
7. To verify the Bernoulli's Theorem.
8. To find critical Reynolds number for a pipe flow.
9. To determine the meta-centric height of a floating body.
10. To determine the minor losses due to sudden enlargement, sudden contraction and bends.
11. To show the velocity and pressure variation with radius in a forced vortex flow.

Course Outcomes:

The students who have undergone the course will be able to

1. To understand the principles and performance characteristics of flow and thermal devices.
2. Characterize the performance of fluid/thermal machinery.

KME352: MATERIAL TESTING LAB

L-T-P
0-0-2

Objectives:

1. To understand the principles and performance characteristics different materials.
2. To know about material properties.

List of Experiments: (At least 8 of the following)

1. Strength test of a given mild steel specimen on UTM with full details and stress versus strain plot on the machine.
2. Other tests such as shear, bend tests on UTM.
3. Impact test on impact testing machine like Charpy, Izod or both.
4. Hardness test of given specimen using Rockwell and Vickers/Brinell testing machines.
5. Spring index test on spring testing machine.
6. Fatigue test on fatigue testing machine.
7. Creep test on creep testing machine.
8. Experiment on deflection of beam, comparison of actual measurement of deflection with dial gauge to the calculated one, and or evaluation of young's modulus of beam.
9. Torsion test of a rod using torsion testing machine.
10. Study of NDT (non-destructive testing) methods like magnetic flaw detector, ultrasonic flaw detector, eddy current testing machine, dye penetrant tests.

Course Outcomes:

The students who have undergone the course will be able to

1. To understand the principles and performance characteristics different materials.
2. Measure various properties of materials.

Objectives:

To provide an overview of how computers can be utilized in mechanical component design.

UNIT-I**Introduction (1 drawing sheets)**

Introduction, classification of machine drawings, principles of drawing, conventional representation of machine components and materials, lines, types of lines, dimensioning types, lines and rules of dimensioning.

Orthographic Projections (3 drawing sheets)

Introduction to orthographic projection, concept of first angle and third angle projection, drawing of simple machine elements in first angle projection, missing line problems, principle of visualization of objects, sectional views, full and half sectional views, auxiliary views.

UNIT-II

Fasteners (2 drawing sheets)

Temporary and permanent fasteners, thread nomenclature and forms, thread series, designation, representation of threads, bolted joints, locking arrangement of nuts, screws, washers, foundation bolts etc., keys, types of keys, cotter and knuckle joints.

UNIT-III

Riveted joints (1 drawing sheet)

Introduction, rivets and riveting, types of rivets, types of riveted joints, drawing of boiler joints etc.

Free hand sketching (1 drawing sheet)

Introduction, Need for free hand sketching, Free hand sketching of foundation bolts, studs, pulleys, couplings etc.

UNIT-IV

Assembly drawing (2 drawing sheets)

Introduction to assembly drawing, drawing assembly drawing of simple machine elements like rigid or flexible coupling, muff coupling, Plummer block, footstep bearing, bracket etc.

UNIT-V

Computer aided drafting (1 drawing)

Introduction to computer aided drafting; advantages and applications of CAD, concepts of computer aided 2D drafting using any drafting software like AutoCAD, Solid Edge, Draft Sight etc., basic draw and modify commands, making 2D drawings of simple machine parts.

Course Outcomes:

Upon completion of this course, the students can

1. Understand the application of mechanical component design using computers
2. Use computer and CAD software for modelling mechanical components.

Books and References:

1. Fundamentals of Machine Drawing by Sadhu Singh & Shah, PHI.
2. Engineering Drawing by Bhat, & Panchal, Charotar Publishing House.
3. Machine Drawing with AutoCAD by Pohit and Ghosh, Pearson.
4. Machine Drawing-KL Narayana, P Kannaiah, KV Reddy, New Age.
5. Machine Drawing, N. Siddeshwar, P Kannaiah, VVS Shastry, Tata McGraw Hill.
6. Engineering Drawing, Pathak, Wiley.
7. Textbook of Machine Drawing, K C John, PHI.
8. AutoCAD 2014 for Engineers & Designers, Bhatt, WILEY

SEMESTER-IV

KME401: APPLIED THERMODYNAMICS

L-T-P
3-0-0

Objectives:

1. To learn about of I law for reacting systems and heating value of fuels.
2. To learn about gas and vapour cycles and their first law and second law efficiencies.
3. To understand about the properties of dry and wet air and the principles of psychrometry.
4. To learn about gas dynamics of air flow and steam through nozzles.
5. To learn the about reciprocating compressors with and without intercooling.
6. To analyze the performance of steam turbines.

UNIT I

Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and equilibrium composition calculations using free energy. Introduction of Otto, Diesel and Dual cycles.

UNIT II

Vapour Power cycles:

Vapor power cycles Rankine cycle with superheat, reheat and regeneration, exergy analysis. Rankine cycle, effect of pressure and temperature on Rankine cycle, Reheat cycle, Regenerative cycle, Feed water heaters, Binary vapour cycle, Combined cycles, Cogeneration.

Fuels and Combustion: Combustion analysis, heating values, air requirement, Air/Fuel ratio, standard heat of reaction and effect of temperature on standard heat of reaction, heat of formation, Adiabatic flame temperature.

UNIT III

Boilers: Classifications and working of boilers, boiler mountings and accessories, Draught and its calculations, air pre-heater, feed water heater, super heater. Boiler efficiency, Equivalent evaporation. Boiler trial and heat balance.

Condenser: Classification of condenser, air leakage, condenser performance parameters.

UNIT IV

Steam and Gas Nozzles: Flow through Convergent and convergent-divergent nozzles, variation of velocity, area and specific volume, choked flow, throat area, Nozzle efficiency, Off design operation of nozzle, Shock waves stationary normal shock waves, Effect of friction on nozzle, Super saturated flow.

Steam Turbines: Classification of steam turbine, Impulse and Reaction turbines, Staging, Stage and Overall efficiency, reheat factor, Bleeding, Velocity diagram of simple and compound multistage impulse and reaction turbines and related calculations, work done, efficiencies of reaction, Impulse reaction turbines, state point locus, Losses in steam turbines, Governing of turbines, Comparison with steam engine.

UNIT V

Gas Turbine: Gas turbine classification, Brayton cycle, Principles of gas turbine, Gas turbine cycles with intercooling, reheat and regeneration and their combinations, Stage efficiency, Polytropic efficiency. Deviation of actual cycles from ideal cycles.

Jet Propulsion: Introduction to the principles of jet propulsion, Turbojet and turboprop engines and their processes, Principle of rocket propulsion, Introduction to Rocket Engine.

Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors.

Course Outcomes:

1. Derive and explain the application of Different Thermodynamic relations and evaluate the combustion of fuels
2. Demonstrate the working of Steam Generators and Condensers and evaluate the performance of Boiler and Condensers
3. Analyse and evaluate the performance of Rankine Cycle, Steam Engine and Nozzles
4. Demonstrate the working of Steam Turbines and Vapour power cycles and solve the numerical on these
5. Explain the working of Gas turbines and Jet propulsion engines and evaluate the performance of Gas turbines and jet engines
6. jet engines

Books and References:

1. Basic and Applied Thermodynamics by P.K. Nag, mcgraw Hill india.
2. Applied thermodynamics by Onkar Singh, New Age International.
3. Applied Thermodynamics for Engineering Technologists by Eastop, Pearson Education.
4. Applied Thermodynamics by Venkanna And Swati, PHI.
5. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.
6. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India
7. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.
8. Theory of Stream Turbine by WJ Kearton.

Objectives:

To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.

UNIT-I:

Two-dimensional force systems: Basic concepts, Laws of motion, Principle of transmissibility of forces, transfer of a force to parallel position, resultant of a force system, simplest resultant of two dimensional concurrent and non-concurrent force systems, and distribution of force systems, free body diagrams, equilibrium and equations of equilibrium.

Friction: Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction.

UNIT-II:

Beam: Introduction, shear force and bending moment, different equations of equilibrium, shear force and bending moment diagram for statically determined beams.

Trusses: Introduction, simple truss and solution of simple truss, methods of F-joint and methods of sections.

UNIT-III:

Centroid and moment of inertia: Centroid of plane, curve, area, volume and composite bodies, moment of inertia of plane area, parallel axis theorem, perpendicular axis theorem, principle moment of inertia, mass moment of inertia of circular ring, disc, cylinder, sphere, and cone about their axis of symmetry.

UNIT-IV:

Kinematics of rigid body: Introduction, plane motion of rigid body, velocity and acceleration under translational and rotational motion, relative velocity.

Kinetics of rigid body: Introduction, force, mass and acceleration, work and energy, impulse and momentum, D'Alembert's principle and dynamic equilibrium.

UNIT-V:

Simple stress and strain: Introduction, normal and shear stresses, stress-strain diagrams for ductile and brittle material, elastic constants, one-dimensional loading of members of varying cross sections, strain energy.

Pure bending of beams: Introduction, simple bending theory, stress in beams of different cross sections.

Torsion: Introduction, torsion of shafts of circular cross sections, torque and twist, shear stress due to torque.

Course Outcomes:

1. Determine resultants and apply conditions of static equilibrium to plane force systems. Analyze problems related to friction
2. Generate and sketch shear force and bending moment diagrams for statically determinate beams. Analyze systems to determine the forces in members of trusses
3. Determine the centroid and moment of inertia
4. Solve problems in kinematic and dynamic systems
5. Derive and apply stress and strain relationships in single and compound members subject to axial force, bending moment and torsion

Books and References:

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
2. Vela Murali, "Engineering Mechanics", Oxford University Press (2010).
3. A Textbook of Engineering Mechanics, R.K. Bansal, Laxmi Publications.
4. Engineering Mechanics, R.S. Khurmi, S.Chand Publishing.
5. Meriam J.L. and Kraige L.G., "Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2", Third Edition, John Wiley & Sons (1993).
6. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3 rd Edition, Vikas Publishing House Pvt. Ltd., (2005).
7. Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, (1998).
8. Engineering mechanics by Irving H. Shames, Prentice-Hall.

KME403: MANUFACTURING PROCESSES

L-T-P
3-1-0

Objectives:

To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

UNIT-I

Conventional Manufacturing processes:

Casting and moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses. Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming (forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) principles of powder metallurgy.

UNIT-II

Metal cutting: Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, cutting tool materials, cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining. Additive manufacturing: Rapid prototyping and rapid tooling Joining/fastening processes: Physics of welding, brazing and soldering; design considerations in welding, Solid and liquid state joining processes; Adhesive bonding.

UNIT-III

Grinding & Super finishing:

Grinding: Grinding wheels, abrasive & bonds, cutting action. Grinding wheel specification. Grinding wheel wear - attritions wear, fracture wear. Dressing and Truing. Max chip thickness and Guest criteria. Surface and cylindrical grinding. Centre-less grinding. Super finishing: Honing, lapping and polishing.

UNIT-IV

Metal Joining (Welding):

Survey of welding and allied processes. Gas welding and cutting, process and equipment. Arc welding: Power sources and consumables. TIG & MIG processes and their parameters. Resistance welding - spot, seam projection etc. Other welding processes such as atomic hydrogen, submerged arc, electroslag, friction welding. Soldering & Brazing. Adhesive bonding. Weld decay in HAZ.

UNIT-V

Unconventional Machining Processes:

Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters. Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire EDM; Electro-chemical machining(ECM), etchant & maskant, process parameters, MRR and surface finish. Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining.

Course Outcomes:

1. To understand different casting and metal forming processes.
2. Demonstrate different metal cutting processes.
3. Introduce different grinding and super finishing processes.
4. Demonstrate different welding process to be used in fabrication of product.
5. Familiarize students with unconventional machining processes for different materials.

Books and References

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014.
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems.
3. Manufacturing Technology by P.N. Rao., McGRAW HILL INDIA.
4. Materials and Manufacturing by Paul Degarmo.
5. Manufacturing Processes by Kaushish, PHI.
6. Principles of Foundry Technology, Jain, McGRAW HILL INDIA
7. Production Technology by RK Jain.
8. Degarmo, Black & Kohser, Materials and Processes in Manufacturing.

KME451: APPLIED THERMODYNAMICS LAB

L-T-P
0-0-2

Objectives:

To understand the principles and performance of various boilers and engines.

List of Experiments: (At least 8 of the following)

1. Study of Fire Tube boiler.
2. Study of Water Tube boiler.
3. Study and working of Two stroke petrol Engine.
4. Study and working of Four stroke petrol Engine.
5. Determination of Indicated H.P. of I.C. Engine by Morse Test.
6. Prepare the heat balance sheet for Diesel Engine test rig.
7. Prepare the heat balance sheet for Petrol Engine test rig.
8. Study and working of two stroke Diesel Engine.
9. Study and working of four stroke Diesel Engine.
10. Study of Velocity compounded steam turbine.
11. Study of Pressure compounded steam turbine.
12. Study of Impulse & Reaction turbine.
13. Study of steam Engine model.
14. Study of Gas Turbine Model.

Course Outcomes:

The student who have undergone the course will be

1. Understand principles of Boilers
2. Understand principle of SI and CI engines
3. Use of engine for the sake of finding the performance
4. Able to identify various properties of system.

KME452: MANUFACTURING PROCESS LAB

**L-T-P
0-0-2**

Objectives:

To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

List of Experiments: (At least 8 of the following along-with study of the machines/processes)

1. Shear-angle determination (using formula) with tube cutting (for orthogonal) on lathe machine.
2. Bolt (thread) making on Lathe machine.
3. Tool grinding (to provide tool angles) on tool-grinder machine.
4. Gear cutting on Milling machine.
5. Machining a block on shaper machine.
6. Finishing of a surface on surface-grinding machine.
7. Drilling holes on drilling machine and study of twist-drill.
8. Study of different types of tools and its angles & materials.
9. Experiment on tool wear and tool life.
10. Experiment on jigs/Fixtures and its uses.
11. Gas welding experiment.
12. Arc welding experiment.
13. Resistance welding experiment.
14. Soldering & Brazing experiment.
15. Study and understanding of limits, fits & tolerances.
16. Study of temperature measuring equipment's.
17. Measurement using Strain gauge.
18. Experiment on dynamometers.
19. To study the displacement using LVDT.

Course Outcomes:

Upon completion of this course, students will be able to understand the different conventional and unconventional manufacturing methods employed for making different products.

Objectives:

To provide an overview of how computers can be utilized in mechanical component design.

Note: All drawing conforms to BIS Codes.

Introduction: Conventional representation of machine components and materials, Conventional representation of surface finish, Roughness number symbol, Symbols of Machine elements and welded joints. Classification of Drawings: Machine drawings, Production drawing, part drawing and assembly drawing. Introduction to detail drawing and bill of materials (BOM).

Limits, Fits and Tolerances: General aspects, Nominal size and basic dimensions, Definitions, Basis of fit or limit system, Systems of specifying tolerances, Designation of holes, Shafts and fits, Commonly used holes and shafts. List of Standard Abbreviation used.

Part Modelling: Introduction to part modelling of simple machine components using any 3D software (like CATIA, PRO E, UGNX, Autodesk Inventor or SOLIDWORKS) covering all commands/ features to develop a part model (Minimum 24 machine components need to be developed).

Part Modelling& Assemblies of: Plummer Block Bearing, Machine Vice, Screw Jack, Engine Stuffing box, Lathe Tailstock, Feed Check Valve and Rams Bottom Safety Valve.

Course Outcomes:

Upon completion of this course, the students can use computer and CAD software for modelling mechanical components.

Books and References:

1. Textbook of Machine Drawing, K C John, PHI.
2. Machine Drawing by K.R. Gopalakrishna, Subhas Stores.
3. A Textbook of Machine Drawing by PS Gill from S.K. Kataria& Sons.
4. Machine Drawing-KL Narayana, P Kannaiah, KV Reddy, New Age publications.
5. Engineering Graphics with AutoCAD, Bethune, PHI.
6. Machine Drawing, N. Siddeshwar, P Kannaiah, VVS Shastry, Tata McGraw Hill.
7. Fundamentals of Machine Drawing, Dr Sadhu Singh & P L Shah, Prantice Hall India.
8. Autodesk Inventor by Examples, Sam Tikoo, Wiley.

EVALUATION SCHEME & SYLLABUS

for

B.TECH

3^{ed} Year

MECHANICAL ENGINEERING

as per AKTU Curriculum

(Effective from Session: 2010-11)

STUDY & EVALUATION SCHEME

B. Tech. Mechanical Engineering

[Effective from Session 2010-11]

YEAR III, SEMESTER-V

S. No.	Course Code	SUBJECT	PERIODS			Evaluation Scheme				Subject Total	Credits
						SESSIONAL EXAM.			ESE		
			L	T	P	CT	TA	Total			
THEORY											
1.	EHU-501	Engineering and Managerial Economics	3	1	0	30	20	50	100	150	3
2.	EME-501	Machine Design-I	2	1	0	15	10	25	50	75	3
3.	EME-502	Theory of Machines-I	3	1	0	30	20	50	100	150	4
4.	EME-503	Manufacturing Science-II	3	1	0	30	20	50	100	150	4
5.	EME-504	Heat & Mass Transfer	3	1	0	30	20	50	100	150	4
6.	EME-505	I.C. Engines & Compressors	2	1	0	15	10	25	50	75	3
7	EHU-111	*Human values & Professional Ethics	2	0	0	15	10	25	50	75	
PRACTICAL/TRAINING/PROJECT											
8	EME-551	Machine Design-I Lab	0	0	2	10	10	20	30	50	1
9.	EME 552	Seminar	0	0	3	-	50	-	-	50	1
10.	EME 553	Manufacturing Science-II Lab	0	1	2	10	10	20	30	50	1
11.	EME 554	Heat & Mass Transfer Lab	0	0	3	10	10	20	30	50	1
12.	GP 501	General Proficiency	-	-	-	-	-	50	-	50	1
		Total	16	7	10	-	-	-	-	1000	26

STUDY & EVALUATION SCHEME

B. Tech. Mechanical Engineering
[Effective from Session 2010-11]
YEAR III, SEMESTER-VI

S. No.	Course Code	SUBJECT	PERIODS			Evaluation Scheme				Subject Total	Credits
						SESSIONAL EXAM.			ESE		
			L	T	P	CT	TA	Total			
THEORY											
1.	EHU-601	Industrial Management	3	0	0	30	20	50	100	150	3
2.	EME-011 to EME-014	Departmental Elective-I	3	1	0	30	20	50	100	150	4
3.	EME-021 to EME-024	Departmental Elective-II	2	1	0	15	10	25	50	75	3
4.	EME-602	Machine Design-II	3	1	0	30	20	50	100	150	4
5.	EME-603	Theory of Machine- II	2	1	0	15	10	25	50	75	3
6.	EME-604	Refrigeration & Air-conditioning	3	1	0	30	20	50	100	150	4
7	EHU	*Human values & Professional Ethics	2	0	0	15	10	25	50	75	
PRACTICAL/TRAINING/PROJECT											
8.	EME-651	Fluid Machinery Lab	0	1	2	10	10	20	30	50	1
9.	EME-652	Machine Design-II Lab	0	0	2	10	10	20	30	50	1
10.	EME-653	Theory of Machines Lab	0	0	3	10	10	20	30	50	1
11.	EME-654	Refrigeration & Air Conditioning Lab	0	0	2	10	10	20	30	50	1
12.	GP-601	General Proficiency	-	-	-	-	-	50	-	50	1
		Total	16	6	9	-	-	-	-	1000	26
		Industrial Training-II of 4 – 6 weeks after VI semester will be evaluated in VII semester									

Note- 4 to 6 Weeks Industrial Training-II after VI semester also to be evaluated in VII semester

DEPARTMENTAL ELECTIVES:

Department Elective - I

5. EME-011 Fluid Machinery
6. EME-012 Unconventional Manufacturing Processes
7. EME-013 Product Development & Design
8. EME-014 Reliability Engineering

Department Elective - II

5. EME-021 Non-Conventional Energy Resources & Utilization
6. EME-022 Advanced Welding Technology
7. EME-023 Optimization Techniques in Engineering
8. EME-024 Mechanical Vibrations

EHU-501: ENGINEERING & MANAGERIAL ECONOMICS

L T P

3 2 0

Unit-I: - Introduction : Meaning, Nature and Scope of Economics, Meaning of Science, Engineering and Technology. Managerial Economics and its scope in engineering perspective.

Unit-II: - Basic Concepts Demand Analysis, Law of Demand, Determinates of Demand, Elasticity of Demand-Price, Income and cross Elasticity. Uses of concept of elasticity of demand in managerial decision.

Unit-III:- Demand forecasting, Meaning, significance and methods of demand forecasting, production function, Laws of returns to scale & Law of Diminishing returns scale. An overview of Short and Long run cost curves – fixed cost, variable cost, average cost, marginal cost, Opportunity cost.

Unit-IV: - Market Structure Perfect Competition, Imperfect competition – Monopolistic, Oligopoly, duopoly sorbent features of price determination and various market conditions.

Unit-V:- National Income, Inflation and Business Cycles Concept of N.I. and Measurement. Meaning of Inflation, Type causes & prevention methods, Phases of business cycle.

Course Outcome (CO)

1. Develop understanding about the significance of economics in decision making that would help them to handle the organizational matters in an effective manner
2. Understand the role of demand and supply which would be beneficial in handling in managerial decision process.
3. familiar & learn about Forecasting method which would be beneficial in handling the production function and cost function more effectively.
4. Learn the importance of financial functions and ratios which would help in solving related problems
5. Carry out and evaluate cost/benefit, Business cycle, Break Even Analysis etc. on one or more economic alternatives under consideration

Objectives:

- To understand the design methodology for machine elements.
- To analyze the forces acting on a machine element and apply the suitable design methodology.
- To understand the various standards and methods of standardization.
- To apply the concept of parametric design and validation by strength analysis.

UNIT I

Introduction

Definition, Design requirements of machine elements, Design procedure, Standards in design, Selection of preferred sizes, Indian Standards designation of carbon & alloy steels, Selection of materials for static and fatigue loads **3**

Design against Static Load

Modes of failure, Factor of safety, Principal Stresses, Stresses due to bending and torsion, Theory of failure **4**

UNIT II

Design against Fluctuating Loads

Cyclic stresses, Fatigue and endurance limit, Stress concentration factor, Stress concentration factor for various machine parts, Notch sensitivity, Design for finite and infinite life, Soderberg, Goodman & Gerber criteria **4**

Riveted Joints-Riveting methods, materials, Types of rivet heads, Types of riveted joints, Caulking and Fullering, Failure of riveted joint, Efficiency of riveted joint, Design of boiler joints, Eccentric loaded riveted joint **4**

UNIT III:

Shafts

Cause of failure in shafts, Materials for shaft, Stresses in shafts, Design of shafts subjected to twisting moment, bending moment and combined twisting and bending moments, Shafts subjected to fatigue loads, Design for rigidity **4**

Keys and Couplings

Types of keys, splines, Selection of square & flat keys, Strength of sunk key, Couplings-Design of rigid and flexible couplings **4**

UNIT IV

Mechanical Springs

Types, Material for helical springs, End connections for compression and tension helical springs, Stresses and deflection of helical springs of circular wire, Design of helical springs subjected to static and fatigue loading **4**

Power Screws

Forms of threads, multiple threads, Efficiency of square threads, Trapezoidal threads, Stresses in screws, Design of screw jack **3**

Note: Design data book is allowed in the examination

Course Outcomes:

1. Understand the customer's need, formulate the problem, draw the design specifications and importance of theories of failure.
2. Understand component behavior subjected to loads and identify the failure criteria.
3. Understand design against fluctuating load and riveted joint.
4. Design of keys, couplings and shaft under various loading conditions.
5. Design mechanical springs and various types of screw threads.

Books and References:

1. Mechanical Engineering Design – Joseph E. Shigely, McGraw Hill Publications
2. Design of Machine Memembers-Alex Valance and VI Doughtie, McGraw Hill Co.
3. Machine design-M.F. Spott, Prentice Hall India
4. Machine Design-Maleev and Hartman, CBS
5. Machine design -Black & Adams, McGraw Hill
6. Machine Design-Sharma and Agrawal, S.K. Katara& Sons
7. Design of Machine Elements-V.B. Bhandari, Tata McGraw Hill Co.

EME 502 : THEORY OF MACHINES – I**L T P 3 1 0****Objective:**

1. To familiarize students with basic types of mechanisms, joints and degrees of freedom to perform position, velocity and acceleration analysis using graphical and analytical methods.
2. To provide students an understanding of different types of mechanisms.
3. To teach the basics of synthesis of simple mechanisms.
4. To teach students the kinematic analysis of cam-follower motion and gear train configurations.

UNIT I**Introduction**

Links-types, Kinematics pairs-classification, Constraints-types, Degrees of freedom of planar mechanism, Grubler's equation, linkage mechanisms, inversions of four bar chain, slider crank chain and double slider crank chain **5**

Velocity in Mechanisms

Velocity of point in mechanism, relative velocity method, Velocities in four bar mechanism, slider crank mechanism and quick return motion mechanism, Rubbing velocity at a pin joint, Instantaneous center method, Types & location of instantaneous centers, Kennedy's theorem, Velocities in four bar mechanism & slider crank mechanism **3**

UNIT II**Acceleration in Mechanisms**

Acceleration of a point on a link, Acceleration diagram, Coriolis component of acceleration, Crank and slotted lever mechanism, Klein's construction for Slider Crank mechanism and Four Bar mechanism, Analytical method for slider crank mechanism **4**

Mechanisms with Lower Pairs

Pantograph, Exact straight line motion mechanisms-Peaucellier's, Hart and Scott Russell mechanisms, Approximate straight line motion mechanisms-Grass-Hopper, Watt and Tchebicheff mechanisms, Analysis of Hooke's joint, Davis and Ackermann steering gear mechanisms. 5

UNIT III

FRICTION

Laws of friction, Friction on inclined plane, Efficiency on inclined plane, Friction in journal bearing-friction circle, Pivots and collar friction-uniform pressure and uniform wear, Belt and pulley drive, Length of open and cross belt drive, Ratio of driving tensions for flat belt drive, centrifugal tension, condition for maximum power transmission, V belt drive 6

Brakes & Dynamometers

Shoe brake, Band brake, Band and Block brake, Absorption and transmission type dynamometers 3

UNIT IV

CAMS

Cams and Followers - Classification & terminology, Cam profile by graphical method with knife edge and radial roller follower for uniform velocity, simple harmonic and parabolic motion of followers, Analytical methods of cam design – tangent cam with roller follower and circular cams with flat faced follower 7

UNIT V

Gears & Gear Trains

Classification & terminology, law of gearing, tooth forms & comparisons, Systems of gear teeth, Length of path of contact, contact ratio, interference & undercutting in involute gear teeth, minimum number of teeth on gear and pinion to avoid interference, simple, compound, reverted and planetary gear trains, Sun and planet gear. 7

Course Outcomes:

1. Ability of understanding the various mechanisms, inversions, and their mobility analysis and also analyze their velocity using graphical and analytical approach.
2. Ability to analyze the acceleration of various links/points in different mechanisms graphically and analytically and also develops the design concepts of different types of mechanism with lower pairs.
3. Understand the concept of friction on inclined plane, belts, and journal bearing and also understand braking and development of device to measure the power with help of dynamometers
4. Knowledge of various Cams, followers and their classifications. Design the Cam profile based on the prescribed follower motion.
5. Ability to understand the gears, terminology, gear trains, and analyze gear tooth profile and interference phenomena.

Books and References:

1. Theory of Machines - Thomas Bevan
2. Theory of Machines and Mechanisms- Shigley
3. Theory of Machines and Mechanisms-Ghosh&Mallik
4. Theory of Machines and Mechanisms- Rao&Dukkipati
5. Theory of Machines-S.S. Rattan
6. Kinematics of Machines-Dr. Sadhu singh
7. Mechanics of Machines – V. Ramamurti
8. Theory of Machines – Khurmi& Gupta
9. Theory of Machines – R. K. Bansal
10. Theory of Machines – V. P. Singh
11. Theory of Machines – Malhotra & Gupta

EME-503 : MANUFACTURING SCIENCE-II**L T P 3 1 0****Objective:**

1. To familiarize with the basic concepts of machining science like mechanics of machining, tool wear, tool life and surface roughness.
2. To familiarize with various single and multipoint cutting tools designing processes.
3. To study the economics of machining process.

Unit-I**Metal Cutting**

Mechanics of metal cutting. Geometry of tool and nomenclature .ASA system Orthogonal vs. oblique cutting. Mechanics of chip formation, types of chips. Shear angle relationship. Merchant's force circle diagram. Cutting forces, power required. Cutting fluids/lubricants. Tool materials. Tool wear and tool life. Machinability. Dynamometer. Brief introduction to machine tool vibration and surface finish. Economics of metal cutting. 9

Unit-II**Machine Tools**

- (i) Lathe: Principle, construction, types, operations, Turret/capstan, semi/Automatic, Tool layout. 2
- (ii) Shaper, slotter, planer : Construction, operations & drives. 1
- (iii) Milling : Construction, Milling cutters, up & down milling. Dividing head & indexing. Max chip thickness & power required. 2
- (iv) Drilling and boring: Drilling, boring, reaming tools. Geometry of twist drills. 2

Unit-III

Grinding & Super finishing

(v) Grinding: Grinding wheels, abrasive & bonds, cutting action. Grinding wheel specification. Grinding wheel wear - attritions wear, fracture wear. Dressing and Truing. Max chip thickness and Guest criteria. Surface and Cylindrical grinding. Centerless grinding. 4

(vi) Super finishing: Honing, lapping, and polishing. 1

Standardization & Interchangeability, Limits, Fits & Tolerance and Surface roughness:

Introduction to Standardization & Interchangeability Limits, Fits, Tolerances and IS standards, Limit-gauges, and surface-roughness. 3

Unit-IV

Metal Joining (Welding)

Survey of welding and allied processes. Gas welding and cutting, process and equipment. Arc welding : Power sources and consumables. TIG & MIG processes and their parameters. Resistance welding - spot, seam projection etc. Other welding processes such as atomic hydrogen, submerged arc, electroslag, friction welding. Soldering & Brazing . 8

Thermodynamic and Metallurgical aspects in welding and weld,.

Shrinkage/residual stress in welds. Distortions & Defects in welds and remedies. Weld decay in HAZ. 2

Unit-V

Introduction to Un-conventional Machining and Welding

Need & benefits, application and working principle of EDM, ECM, LBM, EBM, USM. AJM, WJM. Similarly, non-conventional welding applications such as LBW, USW, EBW, Plasma-arc welding, Diffusion welding, Explosive welding/cladding. 6

Course Outcomes:

1. Discuss the mechanism of metal cutting and different forces acting on the tools and tool wear and tool life.
2. Explain the different gear manufacturing processes and gear finishing operations, to discuss cutting tool material and fluids.
3. Understand the different manufacturing process like grinding and super finishing, discuss jig fixtures.
4. Explore advanced welding process.
5. Understand the different advanced manufacturing process and applications.

Books

1. Manufacturing science by Ghosh and Mallik
2. Fundamentals of Metal Cutting and Machine tools by Boothroyd
3. Production Technology by R.K. Jain
4. Production Technology - H.M.T.
5. Production Engineering Science by P.C. Pandey
6. Modern Machining Processes by P.C. Pandey & H.S. Shan
7. Manufacturing science by Degarmo
8. Fundamentals of metal cutting & machine tools – Juneja & Shekhon

9. Process & materials of manufacturing - Lindburg.

10. Advanced Machining Process - VK Jain

EME-504 HEAT & MASS TRANSFER

L:T:P 3:1:0

Objective:

1. To teach the students to comprehend and evaluate various modes of heat and mass transfer.
2. To help the students to design fin enhanced systems, evaporators, condensers and heat exchangers.
3. To enable the students understand boundary layer theory, condensation and boiling.
4. To expose students to heat exchangers and heat pipes.

UNIT-1 Introduction to Heat Transfer:

Concepts of the mechanisms of heat flows; Conduction, convection and radiation; Effect of temperature on thermal conductivity of materials; Introduction to combined heat transfer mechanism. 2

Conduction:

One-dimensional general differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems; Initial and boundary conditions. 3

Steady State one-dimensional Heat conduction:

Composite Systems in rectangular, cylindrical and spherical coordinates with and without energy generation; Thermal resistance concept; Analogy between heat and electricity flow; Thermal contact resistance; Critical thickness of insulation. 3

UNIT-2

Fins:

Heat transfer from extended surfaces, Fins of uniform cross-sectional area; Errors of measurement of temperature in thermometer wells. 3

Transient Conduction:

Transient heat conduction; Lumped capacitance method; Time constant; unsteady state heat conduction in one dimension only, Heisler charts. 4

UNIT-3

Forced Convection:

Basic concepts; Hydrodynamic boundary layer; Thermal boundary layer; Approximate integral boundary layer analysis; Analogy between momentum and heat transfer in turbulent flow over a flat surface; Mixed boundary layer; Flow over a flat plate; Flow across a single cylinder and a sphere; Flow inside ducts; Empirical heat transfer relations; Relation between fluid friction and heat transfer; Liquid metal heat transfer. 4

Natural Convection:

Physical mechanism of natural convection; Buoyant force; Empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates and cylinders, and sphere; Combined free and forced convection. 3

UNIT-4

Thermal Radiation:

Basic radiation concepts; Radiation properties of surfaces; Black body radiation Planck's law, Wein's displacement law, Stefan Boltzmann law, Kirchoff's law; ; Graybody; Shape factor; Black-body radiation; Radiation exchange between diffuse non blackbodies in an enclosure; Radiation shields; Radiation combined with conduction and convection; Absorption and emission in gaseous medium; Solar radiation; Green house effect. 8

UNIT-5

Heat Exchanger:

Types of heat exchangers; Fouling factors; Overall heat transfer coefficient; Logarithmic mean temperature difference (LMTD) method; Effectiveness-NTU method; Compact heat exchangers. 3

Condensation and Boiling:

Introduction to condensation phenomena; Heat transfer relations for laminar film condensation on vertical surfaces and on outside & inside of a horizontal tube; Effect of non-condensable gases; Dropwise condensation; Heat pipes; Boiling modes, pool boiling; Hysteresis in boiling curve; Forced convective boiling. 3

Introduction to Mass Transfer:

Introduction; Fick's law of diffusion; Steady state equimolar counter diffusion; Steady state diffusion through a stagnant gas film. 2

Course Outcomes:

1. Understand the fundamentals and various modes of heat transfer. Compute the heat transfer rate and temperature distribution in various geometry under steady- state heat conduction with and without heat generation.
2. Understand and analyze the heat transfer through extended surface. Distinguish and evaluate the heat transfer under unsteady-state.
3. Deduce and analyze the forced and free convection heat transfer.
4. Understand the principles of radiation and analyze the thermal radiation exchange among the bodies.
5. Basic of heat exchangers and heat transfer due to phase change. The design of heat exchanger using LMTD and NTU method. Fundamentals and various modes of mass transfer. Interpret and compute the mass transfer rate.

Books:

1. Elements of Heat transfer by Bayazitoglu & Ozisik, McGraw-Hill Book Company.
2. Heat Transfer By J.P. Holman, McGraw-Hill International edition.
3. Schaum's outline of Heat Transfer by Pitts & Sisson McGraw-Hill International edition.
4. Principles of Heat Transfer by Frank Kreith, McGraw-Hill Book co.
5. Fundamentals of Momentum, Heat and Mass Transfer by James R. Welty; John Wiley & Sons (Pvt). Ltd.
6. Heat Transfer, by Vijay Gupta, New Age International (P) Ltd. Publishers
7. Heat Transfer, by Y.V.C. Rao, University Press.
8. Heat Transfer, by R. Yadav, Central Publishing House, Allahabad.

Objective:

1. To introduce students to the working of spark ignition and compression ignition engines.
2. To teach students about the usage of alternate fuels for IC engines.
3. To enhance the understanding of students in engine emissions, pollution and their control.
4. To introduce students to the recent trends in IC Engines like stratification, multi point injection, plasma ignition etc.

Unit-1

Introduction to I.C Engines: Engine classification, Air standard cycles, Otto cycle, Diesel cycle, Dual cycle, Comparison of Otto, Diesel and Dual cycles, Stirling cycle, Ericsson cycles, Actual cycle analysis, Two and four stroke engines, SI and CI engines, Valve timing diagram, Rotary engines, stratified charge engine. 5

Fuels: Fuels for SI and CI engine, Important qualities of SI and CI engine fuels, Rating of SI engine and CI engine fuels, Dopes, Additives, Gaseous fuels, LPG, CNG, Biogas, Producer gas, Alternative fuels for IC engines. 3

Testing and Performance: Performance parameters, Basic measurements, Blow by measurement, Testing of SI and CI engines. 2

Unit-2

SI Engines:

Combustion in SI engine, Flame speed, Ignition delay, Abnormal combustion and its control, combustion chamber design for SI engines. 2

Carburetion, Mixture requirements, Carburetor types, Theory of carburetor, MPFI. 3

Ignition system requirements, Magneto and battery ignition systems, ignition timing and spark plug, Electronic ignition. 2

Unit-3

CI Engine:

Combustion in CI engines, Ignition delay, Knock and its control, Combustion chamber design of CI engines. 2

Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, Fuel injectors, Injection timings. 3

Scavenging in 2 Stroke engines, pollution and its control. 2

Unit-4

Engine Cooling: Different cooling systems, Radiators and cooling fans. 1

Lubrication: Engine friction, Lubrication principle, Type of lubrication, Lubrication oils, Crankcase ventilation. 2

Supercharging: Effect of altitude on power output, Types of supercharging 1

Compressors:

Classification, Reciprocating compressors, Single and Multi stage compressors, Intercooling, Volumetric efficiency. 2

Rotary compressors, Classification, Centrifugal compressor, axial compressors, Surging and stalling, Roots blower, Vaned compressor. 2

Course Outcomes:

1. Understand engines, their classification, air standard cycles and their analysis. Also to acquire knowledge of conventional, alternative fuels for IC engine and testing of IC engines.
2. Understand the combustion system and combustion chamber design for SI engines. Also to understand the ignition system and Carburetion for SI engines.
3. Understand the combustion system and combustion chamber design for CI engines. Also to understand the injection system, pollution and its control for IC Engines.
4. Understand the cooling, lubrication and supercharging systems. Also to understand compressors their classification and to analyze their performance.

BOOKS:

1. Fundamentals of Internal Combustion Engine by Gill, Smith, Ziurs, Oxford & IBH Publishing CO
2. IC Engines, by Rogowsky, International Book Co.
3. A Course in International Combustion Engines, by Mathur & Sharma, Dhanpat Rai & Sons.
4. I.C Engine Analysis & Practice by E.F Obert.
5. I.C Engine, by Ganeshan, Tata McGraw Hill Publishers.
6. I.C Engine, by R. Yadav, Central Publishing House, Allahabad
7. Reciprocating and Rotary Compressors, by Chlumsky, SNTI Publications, Czechoslovakia
8. Turbines, Compressors and Fans, by S.M. Yahya, Tata McGraw Hill Pub.

EME-551 : MACHINE DESIGN-I Lab L T P 0 0 2

Objective:

1. To teach the students working of different types of joints and couplings.
2. To enable the students to draw the different types of joints and couplings.
3. To make the students familiar with the design procedure of the springs, screw jack.

Note: Eight experiments out of the following are to be performed. Students are advised to use design data book for the design. Drawing shall be made wherever necessary on small drawing sheets.

1. Design & drawing of Cotter joint.
2. Design & drawing of Knuckle joint
3. Design of machine components subjected to combined steady and variable loads.
4. Design of eccentrically loaded riveted joint
5. Design of boiler riveted joint
6. Design of shaft for combined constant twisting and bending loads
7. Design of shaft subjected to fluctuating loads
8. Design and drawing of flanged type rigid coupling
9. Design and drawing of flexible coupling

10. Design and drawing of helical spring
11. Design and drawing of screw jack

Lab Outcomes:

Students will be able to

1. Analyze and select the different type of joints and couplings.
2. Know the application of various joints and couplings.
3. Draw isometric drawing of screw jack, joints and couplings.

EME-553: MANUFACTURING SCIENCE -II – LAB
L T P 0 0 3

Objective:

1. To help students perform some exercises on milling machine.
2. To train the students in metal joining process like welding, soldering, etc.
3. To help students perform some exercises on drill machine.
4. To help students perform exercises on lathe such as Bolt (thread) making.

Say, min 8 experiments out of the following (or such experiment along-with study of the machines/processes)

1. Shear-angle determination (using formula) with tube cutting (for orthogonal) on lathe machine.
2. Bolt (thread) making on Lathe machine
3. Tool grinding (to provide tool angles) on tool-grinder machine.
4. Gear cutting on Milling machine.
5. Machining a block on shaper machine.
6. Finishing of a surface on surface-grinding machine.
7. Drilling holes on drilling machine and study of twist-drill.
8. Study of different types of tools and its angles & materials.
9. Experiment on tool wear and tool life.
10. Experiment on jigs/Fixtures and its uses
11. Gas welding experiment
12. Arc welding experiment
13. Resistance welding experiment.
14. Soldering & Brazing experiment
15. Experiment on unconventional machining.
16. Experiment on unconventional welding.
17. Experiment on TIG/MIG Welding.
18. Macro and Microstructure of welding joints, HAZ.

Lab Outcomes:

1. Demonstrate thread cutting and tube cutting on lathe machine.
2. Understand twist-drill and to demonstrate drilling of holes on drilling machines
3. Demonstrate tool grinding, gear cutting and machining experimentally.
4. Acquire the knowledge of different types of tools and its angles. Also to demonstrate the tool life, tool wear experimentally.

5. Demonstrate various low strength and high strength, conventional and non-conventional welding processes.

EME-554: HEAT & MASS TRANSFER – LAB

L T P - 0 1 2

Objective:

1. To enable the students to do experimentation on heat transfer equipment and improve practical knowledge of the systems.
2. To develop trouble shooting abilities of students for practical heat transfer systems.
3. To teach students how to measure heat transfer through various systems.

Minimum 10 experiment of the following.

1. Conduction - Composite wall experiment
2. Conduction - Composite cylinder experiment
3. Convection - Pool Boiling experiment
4. Convection - Experiment on heat transfer from tube-natural convection.
5. Convection - Heat Pipe experiment.
6. Convection - Heat transfer through fin-natural convection .
7. Convection - Heat transfer through tube/fin-forced convection.
8. Any experiment on Stefan's Law, on radiation determination of emissivity, etc.
9. Any experiment on solar collector, etc.
10. Heat exchanger - Parallel flow experiment
11. Heat exchanger - Counter flow experiment
12. Any other suitable experiment on critical insulation thickness.
13. Conduction - Determination of thermal conductivity of fluids.
14. Conduction - Thermal Contact Resistance Effect.

Lab Outcomes:

1. Measure important properties of metals, liquids and insulating materials.
2. Evaluate the variation in fin efficiency and heat transfer during free and forced Convection heat transfer.
3. Measure and estimate the heat transfer coefficient in free and forced convection and correlated with theoretical values.
4. Estimate the overall heat transfer coefficient, LMTD and effectiveness of shell and tube type heat exchange.
5. Measure the emissivity of a surface and estimate the Stefan Boltzmann constant in radiation heat transfer.

EHU-601: INDUSTRIAL MANAGEMENT

L T P -3 2 0

Unit-I:- Introduction : Concept, Development, application and scope of Industrial Management. Productivity: Definition, measurement, productivity index, types of production system, Industrial Ownership.

Unit-II:- Management Function : Principles of Management- Management Tools – time and motion study, work simplification- process charts and flow diagrams, Production Planning, Specification of Production requirements.

Unit-III:- Inventory control : Inventory, cost, Deterministic models, Introduction to supply chain management.

Unit-IV:- Quality control : Meaning, process control, SQC control charts, single, double and sequential sampling, Introduction to TQM.

Unit-V:- Environmental Issues : Environmental Pollution – various management techniques to control Environmental pollution – Various control acts for Air, Water, Solid waste and Noise pollution.

Course Outcome (CO)

1. Understand the technicalities involved in managing organizations by learning different aspects of management
2. Develop an understanding about the environmental issues affecting organizational functioning.
3. Develop proficiency in identifying and applying various management tools and control in order to enhance the efficiency of organizational functioning.
4. Learn different statistical applications to handle quality management as well as other important aspects related to production system
5. Analyze and apply knowledge of contemporary issue along with ethical & legal responsibilities and social norms to enhance the efficiency of organizational functioning.

Objective:

1. To familiarize the various steps involved in the Design Process.
2. To understand the principals involved in evaluating the shape and dimensions of a component.
3. To satisfy functional and strength requirements.
4. To learn to use standard practices and standard data
5. To learn to use catalogues and standard machine components

UNIT I

Spur Gears

Tooth forms, System of gear teeth, contact ratio, Standard proportions of gear systems, Interference in involute gears, Backlash, Selection of gear materials, Gear manufacturing methods, Design considerations, Beam strength of gear tooth, Dynamic tooth load, Wear strength of gear tooth, Failure of gear tooth, Design of spur gears, AGMA and Indian standards. **5**

Helical Gears

Terminology, Proportions for helical gears, Beam strength and wear strength of helical gears, herringbone gears, crossed helical gears, Design of helical gears. **3**

Worm Gears

Types of worms, Terminology, Gear tooth proportions, Efficiency of worm gears, Heat dissipation in worm gearing, Strength and wear tooth load for worm gears, Design of worm gearing **3**

UNIT II

Sliding Contact Bearing

Types, Selection of bearing, Plain journal bearing, Hydrodynamic lubrication, Properties and materials, Lubricants and lubrication, Hydrodynamic journal bearing, Heat generation, Design of journal bearing, Thrust bearing-pivot and collar bearing, Hydrodynamic thrust bearing, **5**

Rolling Contact Bearing

Advantages and disadvantages, Types of ball bearing, Thrust ball bearing, Types of roller bearing, Selection of radial ball bearing, Bearing life, Selection of roller bearings, Dynamic equivalent load for roller contact bearing under constant and variable loading, Reliability of Bearing, Selection of rolling contact bearing, Lubrication of ball and roller bearing, Mounting of bearing **6**

UNIT III

IC ENGINE PARTS

Selection of type of IC engine, General design considerations, Design of Cylinder and cylinder head; Design of piston, piston ring and gudgeon pin; Design of connecting rod; Design of centre crankshaft **6**

Note: There will be three big questions from each unit. Units I & II each consists of 40 marks whereas Unit III consists of 20 marks. Design data book is allowed in the examination.

Course Outcomes:

1. Understand the customer's need, formulate the problem and draw the design specifications.
2. Understand the methods of design of spur gears, helical gears and worm gears.
3. Perform the design of various types of sliding contact, rolling contact bearings.
4. Design the crane hook, connecting rod, machine frame and other similar components of IC Engine.
5. Design a machine component using theories of failure.

Books and References:

1. Mechanical Engineering Design – Joseph E. Shigely, McGraw Hill Publications
2. Design of Machine Memebbers-Alex Valance and VI Doughtie, McGraw Hill Co.
3. Machine design-M.F. Spott, Prentice Hall India
4. Machine Design-Maleev and Hartman, CBS
5. Machine design -Black & Adams, McGraw Hill
6. Machine Design-Sharma and Agrawal, S.K. Katara& Sons
7. Design of Machine Elements-V.B. Bhandari, Tata McGraw Hill Co.

EME-603: THEORY OF MACHINES-II**L T P****2 1 0****Objective:**

1. To understand the concepts of turning moment diagrams, flywheel design and the dynamics of reciprocating engines.
2. To understand the balancing procedures for rotating and reciprocating masses, rotors and engines.
3. To understand the fundamentals of free and forced vibrations.
4. To understand the mechanisms for control.

UNIT I**Static & Dynamic Force Analysis**

Static equilibrium of two/three force members, Static equilibrium of member with two forces and torque, Static force analysis of linkages, D'Alembert's principle, Equivalent offset inertia force, Dynamic force analysis of four link mechanism and slider crank mechanism, Engine force analysis-Piston and crank effort **5**

Turning Moment & Flywheel

Turning moment on crankshaft, Turning moment diagrams-single cylinder double acting steam engine, four stroke IC engine and multi-cylinder steam engine, Fluctuation of energy, Flywheel **3**

UNIT II**Balancing of Machines**

Static and dynamic balancing, Balancing of several masses in the same plane and different planes, Balancing of reciprocating masses, Balancing of primary force in reciprocating engine,

Partial balancing of two cylinder locomotives, Variation of tractive force, swaying couple, hammer blow 7

UNIT III

Governors

Terminology, Centrifugal governors-Watt governor, Dead weight governors-Porter & Proell governor, Spring controlled governor-Hartnell governor, Sensitivity, Stability, Hunting, Isochronism, Effort and Power of governor, Controlling force diagrams for Porter governor and Spring controlled governors 8

UNIT IV

Gyroscopic Motion

Principles, Gyroscopic torque, Effect of gyroscopic couple on the stability of aero planes & automobiles 3

Mechanical Vibrations

Types of vibrations, Degrees of freedom, Single degree free & damped vibrations, Forced vibration of single degree system under harmonic excitation, Critical speeds of shaft 4

Course Outcomes:

1. Analyze static and dynamic force of various linkages. Understanding the concepts & analyze problems on Turning moment and Flywheel.
2. Understand and analyze the balancing of rotating and reciprocating parts in a Machine/mechanism.
3. Ability to understand the concept and working principle of various governors.
4. Understand and analyze the gyroscopic effect on aero-planes, ships and automobile and also to learn the concepts of mechanical vibration and critical speed of shaft.

Books and References:

1. Theory of Machines - Thomas Bevan
2. Theory of Machines and Mechanisms- Shigley
3. Theory of Machines and Mechanisms-Ghosh&Mallik
4. Theory of Machines and Mechanisms- Rao&Dukkipati
5. Theory of Machines - S.S. Rattan
6. Theory of Machines – R.K. Bansal
7. Mechanics of Machines – V. Ramamurti
8. Theory of Machines – Khurmi& Gupta
9. Theory of Machines – P.L. Ballaney
10. Theory of Machines – V. P. Singh

EME 604 : REFRIGERATION & AIR CONDITIONING

L T P 3 1 0

Objective:

1. To enable the students to understand the principles of refrigeration and air conditioning.
2. To teach the students how to calculate the cooling load for different applications of Refrigeration and Air-conditioning.
3. To expose the students to cyclic controls and system balancing.
4. To teach students the principles of psychrometry.
5. To develop the knowledge of students in selecting the right equipment for a particular application of Refrigeration and Air-conditioning.

Unit-1

Refrigeration:

Introduction to refrigeration system, Methods of refrigeration, Carnot refrigeration cycle, Unit of refrigeration, Refrigeration effect & C.O.P.

Air Refrigeration cycle:

Open and closed air refrigeration cycles, Reversed Carnot cycle, Bell Coleman or Reversed Joule air refrigeration cycle, Aircraft refrigeration system, Classification of aircraft refrigeration system. Boot strap refrigeration, Regenerative, Reduced ambient, Dry air rated temperature (DART). 8

Unit-2

Vapour Compression System:

Single stage system, Analysis of vapour compression cycle, Use of T-S and P-H charts, Effect of change in suction and discharge pressures on C.O.P, Effect of subcooling of condensate & superheating of refrigerant vapour on C.O.P of the cycle, Actual vapour compression refrigeration cycle, Multistage vapour compression system requirement, Removal of flash gas, Intercooling, Different configuration of multistage system, Cascade system. 8

Unit-3

Vapour Absorption system;

Working Principal of vapour absorption refrigeration system, Comparison between absorption & compression systems, Elementary idea of refrigerant absorbent mixtures, Temperature – concentration diagram & Enthalpy – concentration diagram, Adiabatic mixing of two streams, Ammonia – Water vapour absorption system, Lithium-Bromide water vapour absorption system, Comparison. 5

Refrigerants:

Classification of refrigerants, Nomenclature, Desirable properties of refrigerants, Common refrigerants, Secondary refrigerants and CFC free refrigerants. 3

Unit-4

Air Conditioning:

Introduction to air conditioning, Psychrometric properties and their definitions, Psychrometric chart, Different Psychrometric processes, Thermal analysis of human body, Effective temperature and comfort chart, Cooling and heating load calculations, Selection of inside & outside design

conditions, Heat transfer through walls & roofs, Infiltration & ventilation, Internal heat gain, Sensible heat factor (SHF), By pass factor, Grand Sensible heat factor (GSHF), Apparatus dew point (ADP). 8

Unit-5

Refrigeration Equipment & Application:

Elementary knowledge of refrigeration & air conditioning equipmentse.g compressors, condensers, evaporators & expansion devices, Air washers, Cooling towers & humidifying efficiency, Food preservation, Cold storage, Refrigerates Freezers, Ice plant, Water coolers, Elementary knowledge of transmission and distribution of air through ducts and fans, Basic difference between comfort and industrial air conditioning. 7

Course Outcomes:

1. Understand the principles and applications of refrigeration system.
2. Analyse performance of vapour compression refrigeration system.
3. Analyse air conditioning process using principles of psychometry.
4. Study the working principles of vapour absorption, thermoelectric, steam jet refrigeration.
5. Evaluate the cooling and heating loads in air-conditioning system.

Books:

1. Refrigeration and Air conditioning, by Manohar Prasad, New Age International (P) Ltd. Pub.
2. Refrigeration and Air conditioning by C.P Arora.
3. Refrigeration and Air conditioning by Arora & Domkundwar.
4. Refrigeration and Air conditioning by stoecker & Jones.
5. Refrigeration and Air conditioning by Roy J. Dossat.
6. Refrigeration and Air conditioning by P.L. Baloney.
7. Thermal Environment Engg. By Kuhen, Ramsey & Thelked.

EME-011: FLUID MACHINERY

Objective:

1. To enable the students to understand the basics of hydraulics.
2. Improve students' knowledge on hydraulic pumps and various power supply sources.
3. To teach students about the hydraulic turbines and accumulators.
4. Introduce students to Special duty pumps, Intensifier and Hydraulic press.

UNIT-I

Introduction:

Classification of Fluid Machines & Devices, Application of momentum and momentum equation to flow through hydraulic machinery, Euler's fundamental equation. 4

Impact of jet:

Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat & curve), Effect of inclination of jet with the surface.

Hydraulic Turbines:

Classification of turbines, Impulse turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Governing of Pelton wheel. 4

UNIT-II

Reaction Turbines:

Francis and Kaplan turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Degree of reaction, Draft tube, Cavitation in turbines, Principles of similarity, Unit and specific speed, Performance characteristics, Selection of water turbines. 8

UNIT-III

Centrifugal Pumps:

Classifications of centrifugal pumps, Vector diagram, Work done by impeller, Efficiencies of centrifugal pumps, Specific speed, Model testing, Cavitation & separation and their control, Performance characteristics. 7

UNIT-IV

Positive Displacement Pumps:

Reciprocating pump theory, Slip and coefficient of discharge, Indicator diagram, Effect and acceleration, Work saved by fitting air vessels, Comparison of centrifugal and reciprocating pumps, Positive rotary pumps, Gear and Vane pumps, Performance characteristics. 6

UNIT-V

Other Machines:

Hydraulic accumulator, Special duty pumps, Intensifier, Hydraulic press, Lift and cranes, Theory of hydraulic coupling and torque converters, Performance characteristics. 5

Water Lifting Devices :

Hydraulic ram, Jet pumps, Air lift pumps.

Course Outcomes:

1. Understand the basics of the hydro machinery and the components, function and use of different types of turbines and pumps.
2. Classify fluid and roto dynamic machines.
3. Identify and describe hydraulic turbines and their classifications.
4. Describe centrifugal and mixed flow pumps and fans and the related effects on systems.
5. Estimate the hydraulic parameters and select the required hydraulic machine (pump).

BOOKS:

1. Hydraulic Machines by Jagdish Lal, Metropolitan book co. Pvt ltd.
2. Hydraulic Machines: Theory & Design, V.P.Vasandhani, Khanna Pub.
3. Applied Hydraulics by Addison
4. Hydraulic Machines by R K Rajput, S.Chand & co Ltd.
5. Hydraulic Machines by D S Kumar

EME-021: NON-CONVENTIONAL ENERGY RESOURCES AND UTILISATION

Objective:

1. To impart the knowledge of basics of different non conventional types of power generation & power plants in detail so that it helps them in understanding the need and role of Non-Conventional Energy sources particularly when the conventional sources are scarce in nature.
2. Understand the solar and wind energy concepts.
3. Gain knowledge on biomass energy.

UNIT-I

Energy resources and their utilization:

Indian and global energy sources, Energy exploited, Energy planning, Energy parameters (energy intensity, energy-GDP elasticity), Introduction to various sources of energy, Solar thermal, Photovoltaic, Water power, Wind energy, Biomass, Ocean thermal, Tidal and wave energy, Geothermal energy, Hydrogen energy systems, Fuel cells, Decentralized and dispersed generation.

Solar radiations: Extra terrestrial radiation, Spectral distribution, Solar constant, Solar radiations on earth, measurement of solar radiation, solar radiation geometry, flux on plane surface, latitude, Declination Angle, Surface azimuth angle, Hour angle, Zenith angle, Solar, altitude angle expression for angle between incident beam and the normal to a plane, surface (no derivation), Local apparent time, Apparent motion of sun, Day length, Solar radiation data for India.

UNIT-II

Solar energy:

Solar thermal power and its conversion, Solar collectors, Flat plate, Performance, analysis of flat plate collector, Solar concentrating collectors, Types of concentrating collectors, Thermodynamic limits to concentration, Cylindrical collectors, Thermal analysis of solar collectors, Tracking CPC and solar swing, Solar thermal energy storage, Different systems, Solar pond. Applications, Water heating, Space heating & cooling, Solar distillation, solar pumping, solar cooking, Greenhouses, Solar power plants

Solar photovoltaic system:

Photovoltaic effect, Efficiency of solar cells, Semiconductor materials for solar cells, Solar photovoltaic system, Standards of solar photovoltaic system, Applications of PV system, PV hybrid system

UNIT-III

Biogas:

Photosynthesis, Bio gas production Aerobic and anaerobic bio-conversion process, Raw materials, Properties of bio gas, Producer gas, Transportation of bio gas, bio gas plant technology & status, Community biogas plants, Problems involved in bio gas production, Bio gas applications, Biomass conversion techniques, Biomass gasification, Energy recovery from urban waste, Power generation from liquid waste, Biomass cogeneration, Energy plantation, Fuel properties, Biomass resource development in India.

Wind energy:

Properties of wind, Availability of wind energy in India, wind velocity, Wind

UNIT-IV

Electrochemical effects and fuel cells:

Principle of operation of an acidic fuel cell, Reusable cells, Ideal fuel cells, Other types of fuel cells, Comparison between acidic and alkaline hydrogen oxygen fuel cells, Efficiency and EMF of fuel cells, Operating characteristics of fuel cells, Advantages of fuel cell power plants, Future potential of fuel cells

Tidal power:

Tides and waves as sources of energy, Fundamentals of tidal power, Use of tidal energy Limitations of tidal energy conversion systems. 2

Hydrogen Energy:

Properties of hydrogen in respect of its use as source of renewable energy, Sources of hydrogen, Production of hydrogen, Storage and transportation, Problems with hydrogen as fuel, Development of hydrogen cartridge, Economics of hydrogen fuel and its use

UNIT-V

Thermoelectric systems:

Kelvin relations, power generation, Properties of thermoelectric materials, Fusion Plasma generators.

Geothermal energy:

Structure of earth's interior, Geothermal sites, earthquakes & volcanoes, Geothermal resources, Hot springs, Steam ejection, Principle of working, Types of geothermal station with schematic representation, Site selection for geothermal power plants. Advanced concepts, Problems associated with geothermal conversion.

Ocean energy;

Principle of ocean thermal energy conversion, Wave energy conversion machines, Power plants based on ocean energy, Problems associated with ocean thermal energy conversion systems, Thermoelectric OTEC, Developments of OTEC, Economics . Impact of renewable energy generation on environment, Kyoto Protocol, Cost of electricity production from different energy sources, Energy options for Indian economy.

Course Outcomes:

1. Understand the energy resources, their classification, solar radiation and various sun earth angles.
2. Understand the ways of utilizing solar thermal energy (namely plate collectors and PV cells) and to analyze the performance of the same.
3. Perceive various mechanisms to convert biomass in to cleaner fuels and to acquire knowledge about designing and harnessing the wind energy.
4. Understand the electrochemical devices like fuel cells which can provide the sustainable energy solutions in future and also to understand tidal power and production, transportation and storage of hydrogen as a fuel.
5. Perceive various principles regarding thermoelectric materials to generate electric power. Also to acquire knowledge about geothermal energy, OTEC and to understand international protocols regarding renewable energy generation.

BOOKS:

1. Non-Conventional Sources of Energy by: G.D. Rai, Khanna Publishers.
2. Bio Energy by David Boyles, Elis Horwood Ltd.,
3. Renewable energy sources and conversion technology by N.K. Bansal, M. Kleemann, M. Heliss, Tata McGraw Hill 1990.
4. Direct Energy Conversion by R. A. Coombie, Pitman.
5. Bio Energy Spectrum, Bio Energy and Wasteland Development Organization by O.P Vimal and P.D. Tyagi.

EME-651: FLUID MACHINERY Lab**L T P 0 1 2****Objective:**

1. To make the students familiar with the working of hydraulic turbines and hydraulic pumps.
2. To develop understanding about the performance parameters of hydraulic turbines and hydraulic pumps.
3. Realize the requirements, usage and limitation of hydraulic machines for different applications.

Minimum 8 experiments from following.

1. Impact of Jet experiment.
2. Turbine experiment on Pelton wheel.
3. Turbine experiment on Francis turbine.
4. Turbine experiment on Kaplan turbine.
5. Experiment on Reciprocating pump.
6. Experiment on centrifugal pump.
7. Experiment on Hydraulic Jack/Press
8. Experiment on Hydraulic Brake
9. Experiment on Hydraulic Ram
10. Study through detailed visit of any water pumping station/plant
11. Any other suitable experiment/test rig such as comparison & performance of different types of pumps and turbines.
12. Experiment on Compressor
13. Experiment for measurement of drag and lift on aerofoil in wind tunnel

Course Outcomes:

1. Understand working of water lifting devices and find performance parameters.
2. Comprehend and analyze applications of fluid power in braking, lifting and other hydraulic devices.
3. Understand and estimate the drag and lift forces.
4. Understand the functioning of different special purpose pumps.

EME-652 : MACHINE DESIGN-II Lab

L T P

0 1 2

Objective:

1. To teach the students about computer languages such as C and C++ .
2. To develop understanding about general software programmes for the design of machine components.

A. Computer and Language : students are required to learn the basics of computer language such as C and C++ so that they should be able to write the computer programme. (3 *practical turns*)

B. Writing Computer programme for conventional design: Students are required to write computer program and validate it for the design of machine components done in theory subject (5 *practical turns*)

C. Mini Project: Each student will be given a real life problem for the complete design of a subsystem/system using either manual calculation with the help of design handbook or through computer programme, if needed. This will be done as home assignment to be submitted at the end of the semester.

Course Outcomes:

1. Approach a design problem as a mini project involving decisions when there is not a unique solution.
2. Analysis of IC engine parts such as cylinder, piston, crank shaft.

EME-653 : THEORY OF MACHINES LAB

L T P 0 0 2

Objective:

1. To make the students familiar with the working of governors and flywheels.
2. To develop understanding about the critical speed of shaft.
3. To familiarize the students with the working of the gear train.
4. To teach the students about vibration.

Note: Eight experiments out of the following are to be conducted

1. Study of simple linkage models/mechanisms
2. Study of inversions of four bar linkage
3. Study of inversions of single/double slider crank mechanisms
4. Experiment on Gears tooth profile, interference etc.
5. Experiment on Gear trains
6. Experiment on longitudinal vibration
7. Experiment on transverse vibration
8. Experiments on dead weight type governor
9. Experiment on spring controlled governor

10. Experiment on critical speed of shaft
11. Experiment on gyroscope
12. Experiment on static/dynamic balancing
13. Experiment on Brake
14. Experiment on clutch

Course Outcomes:

1. Ability of understanding the various mechanisms and inversion of four bar, single/double slider crank mechanism.
2. To understand the concept of Gyroscopic couple by performing the experiment on motorised gyroscope.
3. Ability to understand the characteristics of dead weight type governor & spring controlled governor through experimentation.
4. Experiment on longitudinal vibration & critical speed of shaft.
5. To understand the working of Gear trains, brake and clutch.

EME-654 : REFRIGERATION & AIR CONDITIONING Lab

L T P 0 0 2

Objective:

1. To study operating principles of vapour Compression system.
2. To study components of refrigeration and air conditioning systems.
3. To study controls and applications of refrigeration and air conditioning.

Minimum 8 experiments out of following;

1. Experiment on refrigeration test rig and calculation of various performance parameters.
2. To study different types of expansion devices used in refrigeration system.
3. To study different types of evaporators used in refrigeration systems.
4. To study basic components of air-conditioning system.
5. Experiment on air-conditioning test rig & calculation of various performance parameters.
6. To study air washers
7. Study of window air conditioner.
8. Study & determination of volumetric efficiency of compressor.
9. Visit of a central air conditioning plant and its detailed study.
10. Visit of cold-storage and its detailed study.
11. Experiment on Ice-plant.
12. Experiment on two stage Reciprocating compressor for determination of volumetric efficiency, PV diagram and effect of intercooling.
13. Study of Hermetically sealed compressor.
14. Experiment on Desert coolers.

Course Outcomes:

1. Evaluate various performance parameters on refrigeration test rig.
2. Understand various expansion devices and evaporators used in refrigeration systems

3. Acquire the knowledge of various components of air-conditioning system.
4. Evaluate various performance parameters on air-conditioning test rig.
5. Understand window air conditioner.

EVALUATION SCHEME & SYLLABUS

for

B.TECH

4th Year

MECHANICAL ENGINEERING

as per AKTU Curriculum

(Effective from Session: 2011-12)

STUDY & EVALUATION SCHEME

B. Tech. Mechanical Engineering

[Effective from Session 20011-12]

YEAR IV, SEMESTER-VII

S. No.	Course Code	SUBJECT	PERIODS			Evaluation Scheme				Subject Total	Credits
						SESSIONAL EXAM.			ESE		
			L	T	P	CT	TA	Total			
THEORY											
1.	EOE-071-EOE-074	Open Elective-I**	3	1	0	30	20	50	100	150	4
2.	EME-031 to EME-036	Departmental Elective-III	3	1	0	30	20	50	100	150	4
3.	EME-041 to EME-046	Departmental Elective-IV	3	1	0	30	20	50	100	150	4
4.	EME-701	Computer Aided Design	3	1	0	30	20	50	100	150	4
5.	EME-702	Automobile Engineering	3	1	0	30	20	50	100	150	4
6	EHU-111	*Human values & professional Ethics	2	0	0	15	10	25	50	75	
PRACTICAL/TRAINING/PROJECT											
7.	EME-751	CAD/CAM Lab	0	1	2	10	10	20	30	50	1
8.	EME-752	I.C.Engine & Automobile Lab	0	0	2	10	10	20	30	50	1
9	EME-753	Project	0	0	3	-	50	50	-	50	2
10	EME-754	Industrial Training I & II Evaluation and viva-	0	0	2		50	50	-	50	1
11.	GP 701	General Proficiency	-	-	-	-	-	50	-	50	1
		Total	15	6	9	-	-	-	-	1000	26

Note-***Practical Training-1 & 2 (4-weeks each) done after 4th & 6th Semesters would be evaluated in 7th semester through Report and viva voice etc.

* Project should be initiated in 7th semester beginning, and should be completed by the end of 8th semester with good Report and power-point Presentation etc.

Paper Code Open Electives – I

EOE-071	Entrepreneurship Development
EOE-072	Quality Management
EOE-073	Operations Research
EOE-074	Introduction to Biotechnology

DEPARTMENTAL ELECTIVES:

Department Elective - III

- EME-031 Computer Aided Manufacturing
- EME-032 Project Management
- EME-033 Advanced Fluid Mechanics
- EME-034 Experimental Stress Analysis
- EME-035 Advanced Dynamics of Machines
- EME-036 Management Information System

Department Elective - IV

- EME-041 Total Quality Management
- EME-042 Thermal Turbo Machines
- EME-043 Mechanical System Design
- EME-044 Tribology
- EME-045 Industrial Ergonomics
- EME-046 Concurrent Engineering

STUDY & EVALUATION SCHEME

B. Tech. Mechanical Engineering

[Effective from Session 2011-12]

YEAR IV, SEMESTER-VIII

S. No.	Course Code	SUBJECT	PERIODS			Evaluation Scheme				Subject Total
						SESSIONAL EXAM.			ESE	
			L	T	P	CT	TA	Total		
THEORY										
1.	EOE-081-EOE-084	Open Elective-II**	3	1	0	30	20	50	100	150
2.	EME-051 to EME-056	Departmental Elective - V	3	1	0	30	20	50	100	150
3.	EME-061 to EME-066	Departmental Elective – VI	3	1	0	30	20	50	100	150
4.	EME-801	Power Plant Engineering	3	1	0	30	20	50	100	150
7	EHU	*Human values & professional Ethics	2	0	0	15	10	25	50	75
PRACTICAL/TRAINING/PROJECT										
6.	EME-851	Project	0	0	12	-	100	100	250	350
10.	GP-601	General Proficiency	-	-	-	-	-	50	-	50
		Total	12	3	12	-	-	-	-	1000

Paper Code Open Electives – II

EOE-081	Non Conventional Energy Resources
EOE-082	Nonlinear Dynamic Systems
EOE-083	Product Development
EOE-084	Automation and Robotics

DEPARTMENTAL ELECTIVES:

Department Elective-V

- EME-051 Operations Research
- EME-052 Maintenance Engineering & Management
- EME-053 Design of Thermal Systems
- EME-054 Advanced Synthesis of Mechanisms
- EME-055 Six Sigma Methods & Applications
- EME-056 Concepts of Modern Physics

Department Elective-VI

- EME-061 Finite Element Method
- EME-062 Non-Destructive Testing
- EME-063 Advanced Materials Technology
- EME-064 Production & Operations Management
- EME-065 Energy Management
- EME-066 Fundamentals of Bio Medical Engineering

Note: (1) The students who had taken Open elective EME-073 Operations Research in VII Sem. can not take the course EME-051 Operations Research as a Departmental Elective in VIII Sem.

- (2) The students who had taken departmental elective EME 021 Non Conventional Energy Resources & Utilization in VI Sem. can not take the open elective course EOE-081 Non Conventional Energy Resources in VIII Semester.

EME-701 COMPUTER AIDED DESIGN (CAD)

LTP 310

Course objective-

1. The objective of the course Computer Aided Design (CAD) is to impart the knowledge of mathematical elements of CAD to the students.
2. It is aimed to make the student aware of the 2D and 3D transformations of objects for display and data exchange formats for CAD and CAM.
3. It is aimed at imparting the knowledge of fundamentals of design of curves, surfaces and solid models to the students.
4. To help students gain knowledge about standard CAD packages on modeling and drafting

Syllabus-

UNIT-I

Introduction:

Introduction to CAD/CAED/CAE, Elements of CAD, Essential requirements of CAD, Concepts of integrated CAD/CAM, Necessity & its importance, Engineering Applications Computer Graphics-ICAD/CAM systems, Graphics Input devices-cursor control Devices, Digitizers, Keyboard terminals, Image scanner, Speech control devices and Touch, panels, Graphics display devices-Cathode Ray Tube, Random & Raster scan display, Colour CRT monitors, Direct View Storage Tubes, Flat Panel display, Hard copy printers and plotters

UNIT-II

Computer Graphics-II

Graphics standards, Graphics Software, Software Configuration, Graphics Functions, Output primitives- Bresenham's line drawing algorithm and Bresenham's circle generating algorithm

Geometric Transformations:

World/device Coordinate Representation, Windowing and clipping, 2 D Geometric transformations-Translation, Scaling, Shearing, Rotation & Reflection Matrix representation, Composite transformation, 3 D transformations, multiple transformation

UNIT-III

Curves:

Curves representation, Properties of curve design and representation, Interpolation vs approximation, Parametric representation of analytic curves, Parametric continuity conditions, Parametric representation of synthetic curves-Hermite cubic splines-Blending function formulation and its properties, Bezier curves-Blending function formulation and its properties, Composite Bezier curves, B-spline curves and its properties, Periodic and non-periodic B-spline curves

UNIT-IV

3D Graphics:

Polygon surfaces-Polygon mesh representations, Quadric and Super quadric surfaces and blobby objects; Solid modeling-Solid entities, Fundamentals of Solid modeling-Set theory, regularized set operations; Half spaces, Boundary representation, Constructive solid geometry, Sweep representation, Color models

Application commands for AutoCAD & ProE software

UNIT-V

Numerical Methods:

Introduction, Errors in numbers, Binary representation of numbers, Root finding-Bisection method, Newton Raphson method, Curve fitting-Least square method, Numerical differentiation-Newton's interpolation, Numerical Integration-Trapezoidal and Simpson method

Finite Element Method:

Introduction, Principles of Finite elements modeling, Stiffness matrix/displacement matrix, Stiffness matrix for spring system, bar & beam elements, bar elements in 2Dspace (truss element)

Course Outcome-

Student will be able to

1. Understand necessity & importance of CAD in engineering applications,
2. Understand the basics of graphics and also able to solve the various geometric transformation like (Translation, Scaling, Shearing, Rotation & Reflection etc,)
3. Develop mathematical models to represent various curves like (Hermite cubic splines, Bezier curves, B-spline curves)
4. Represent mathematical models of various solid entities.
5. Able to solve various linear and non-linear equations and basic knowledge of FEM.

Books & References:

1. Computer Graphics Hearn & Baker Prentice Hall of India
2. Computer Aided Engineering Design Anupam Saxena & B.SahayAnamaya Publishers
3. CAD/CAM HP Groover & EW Zimmers, Jr. Prentice Hall India Ltd.
4. CAD/CAM Theory and Practice Ibrahim Zeid & R SivasubramaniamMcGraw Hill
5. Computer Aided Design RK Srivastava Umesh Publications
6. Mathematical Elements for ComputerGraphicsDF Rogers & JA Adams McGraw Hill
7. Finite Element Method SS Rao
8. FE Analysis Theory and Programming CS Krishnamoorthy Tata McGraw Hill
9. Numerical Method for Engg Computation MK Jain, SRK Iyenger &RK JainWiley Eastern Limited
10. Computer Oriented Numerical Methods V Rajaraman Prentice Hall of India

EME -702 AUTOMOBILE ENGINEERING

LTP 310

Course objective-

1. To broaden the understanding of students in the structure of vehicle chassis and engines.
2. To introduce students to steering, suspension, braking and transmission systems.
3. To introduce students to engine auxiliary systems like heating, ventilation and air-conditioning.
4. To teach students about the importance of alternate fuels and modifying the engine suitably.

UNIT-I

Power Unit and Gear Box:

Principles of Design of main components. Valve mechanism. Power and Torque characteristics. Rolling, air and gradient resistance. Tractive effort. Gear Box. Gear ratio determination. Design of Gear box.

UNIT-II

Transmission System:

Requirements. Clutches. Torque converters. Over Drive and free wheel, Universal joint. Differential Gear Mechanism of Rear Axle. Automatic transmission, Steering and Front Axle. Castor Angle, wheel camber & Toe-in, Toe-out etc. Steering geometry. Ackerman mechanism, Under steer and Over steer.

UNIT-III

Braking System:

General requirements, Road, tyre adhesion, weight transfer, Braking ratio, Mechanical brakes, Hydraulic brakes. Vacuum and air brakes. Thermal aspects. 5

Chasis and Suspension System:

Loads on the frame. Strength and stiffness. Various suspension systems. 3

UNIT-IV

Electrical System:

Types of starting motors, generator & regulators, lighting system, Ignition system, Horn, Battery etc.

Fuel Supply System:

Diesel & Petrol vehicle system such as Fuel Injection Pump, Injector & Fuel Pump, Carburetor etc. MPFI.

Unit-V

Automobile Air Conditioning:

Requirements, Cooling & heating systems.

Cooling & Lubrication System:

Different type of cooling system and lubrication system.

Maintenance system:

Preventive maintenance, break down maintenance and over hauling.

Course Outcome-

Student will be able to

1. Understand the need of a gear box in an automobile and to design the same
2. Perceive the requirement and working principle of transmission systems (clutches, universal joints, torque convertors and steering systems) and to analyze the same.
3. Understand the general requirements and thermal aspects of braking systems. Also to perceive various types of suspension systems.
4. Perceive the need and working of Electrical systems (Starting systems, Lighting systems and Ignition systems) and the fuel supply systems in an automobile.
5. Understand the requirement and working of 'Automobile air-conditioning', 'cooling and lubrication systems' and 'maintenance systems' in an automobile.

References

1. Automotive Engineering- Hietner
2. Automobile Engineering - Kripal Singh.
3. Automobile Engineering - Narang.
4. Automotive Mechanics- Crouse
5. Automobile Engineering - Newton and Steeds.

EME-801: POWER PLANT ENGINEERING

LTP 310

Course objective-

1. To teach students about the working of various power generation units and steam cycles.
2. To introduce students to steam generators, combustion and firing methods in order to make the fullest use of thermal power potentialities of the country.
3. To enable students understand in detail about nuclear, gas turbine, hydro and diesel power plants which play an important role in power generation.

UNIT-I

Introduction

Power and energy, sources of energy, review of thermodynamic cycles related to power plants, fuels and combustion calculations. 3

Load estimation, load curves, various terms and factors involved in power plant calculations. Effect of variable load on power plant operation, Selection of power plant units. 2

Power plant economics and selection Effect of plant type on costs, rates, fixed elements, energy elements, customer elements and investor's profit; depreciation and replacement, theory of rates. Economics of plant selection, other considerations in plant selection. 3

UNIT-II

Steam power plant

General layout of steam power plant, Power plant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and accessories, Different systems such as coal handling system, pulverizers and coal burners, combustion system, draft, ash handling system, Dust collection system, Feed water treatment and condenser and cooling towers and cooling ponds, Turbine auxiliary systems such as governing, feed heating, reheating, flange heating and gland leakage. Operation and maintenance of steam power plant, heat balance and efficiency, Site selection of a steam power plant. 8

UNIT-III

Diesel power plant

General layout, Components of Diesel power plant, Performance of diesel power plant, fuel system, lubrication system, air intake and admission system, supercharging system, exhaust system, diesel plant operation and efficiency, heat balance, Site selection of diesel power plant, Comparative study of diesel power plant with steam power plant. 2

Gas turbine power plant

Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, Combined cycle power plants, Site selection of gas turbine power plant 6

UNIT-IV

Nuclear power plant

Principles of nuclear energy, Lay out of nuclear power plant, Basic components of nuclear reactions, nuclear power station, Nuclear waste disposal, Site selection of nuclear power plants. 3
Hydro-electric station Hydrology, Principles of working, applications, site selection, classification and arrangements, hydro-electric plants, run off size of plant and choice of units, operation and maintenance, hydro systems, interconnected systems. 4

Non-Conventional Power Plants

Introduction to non-conventional power plants (Solar, wind, geothermal, tidal)etc. 2

UNIT-V

Electrical system

Generators and generator cooling, transformers and their cooling, bus bar, etc. 2

Instrumentation

Purpose, classification, selection and application, recorders and their use, listing of various control rooms. 3

Pollution

Pollution due to power generation 2

Course Outcome-

Student will be able to

1. Understand and evaluate the various types of fuels and power cycles and its application in power plant. Evaluate the various loads and economical feasibility of power generation units.
2. Evaluate the design layout and working of various components of steam power plant.
3. Understand and analyze the working of Diesel engine and gas turbine power plants.
4. Evaluate the design layout and working of nuclear and hydro electric power plants.
5. Understand and analyze the various non-conventional power plants and electrical & pollution control systems use in power plant

References

1. "Power Plant Engineering" F.T. Morse, Affiliated East-West Press Pvt. Ltd, New Delhi/Madras.
2. "Power Plant Engineering" Mahesh Verma, Metropolitan Book Company Pvt. Ltd. New Delhi.
3. "Power Plant Technology" El-Vakil, McGraw Hill.
4. Power Plant Engineering by P.K. Nag, Tata McGraw Hill.
5. Steam & Gas Turbines & Power Plant Engineering by R.Yadav, Central Pub.House.

EPI- 801: QUALITY CONTROL

Course objective-

1. To achieve the satisfactory level of quality must be achieved with a minimum cost
2. To enable the students understand the principles of Quality Management
3. To provide students details of quality planning and TQM techniques
4. Eliminating assignable (special) sources of variation product outcome, so that the process is stable.
5. Monitoring the ongoing production process, assisted by the use of control charts, to detect significant changes of mean or variation.

UNIT-I

Introduction: Concept and evaluation of quality control. Measurement & Metrology, precision vs accuracy. Process capability, standardization & Interchangeability. 3

Inspection and Gauges: Inspection methods. Types of Gauges. Limits Fits and Tolerances. Non-Destructive Testing& Evaluation. 5

UNIT-II

Control Charts for SQC: Statistical Quality Control (SQC). Control charts for variables such as X, R charts and control charts for attributes such as p-chart, c-chart. Construction & use of the control charts. Process capability.

UNIT-III

Acceptance Sampling for SQC: Principle of acceptance sampling. Producer's and consumer's risk. Sampling plans –single, double & sequential. Sampling by attributes and variables. 7

UNIT-IV

Reliability: Introduction to reliability, bath-tub curve. Life expectancy. Reliability based design. Series & Parallel System. 3

Defect Diagnosis and prevention: Basic causes of failure, curve/control of failure.

MTBF. Maintainability, Condition monitoring and diagnostic techniques. 4

Value Engineering: Elements of value analysis, Techniques. 2

UNIT-V:

TQM: Basic Concept, Quality control, Quality Assurance and Quality Management and Total Quality Management. Implementation of TQM. ISO 9000 and its series, Zero-defect. . Taguchi method, Six Sigma concepts. 6

Other Factors in Quality: Human Factors such as attitude and errors. Material-Quality, Quality circles, Quality in sales & service. 2

Course Outcome-

Student will be able to

1. Understand the role of statistical tools in quality improvement.
2. Understand the different types of variability, rational subgroups, and how a control chart is used to detect assignable causes.
3. Construct and interpret control charts for variables such as \bar{x} , r , s , and individuals charts.

Reference:

1. Statistical Quality Control by Grant and Leavenworth, McGraw Hill
2. Maintenance for Reliability by Rao.

EME-061: FINITE ELEMENT METHOD

Course Objective-

1. To enable the students understand the mathematical and physical principles underlying the Finite Element Method (FEM) as applied to solid mechanics, heat transfer and fluid flow problems.
2. To teach the students the characteristics of various elements and selection of suitable elements for the problems being solved.
3. To make the students derive finite element equations for simple and complex elements

UNIT-I

Introduction

Introduction to finite difference method and finite elements method, Advantages and limitations, Mathematical formulation of FEM, Different approaches in Finite Element Method - Direct Stiffness approach, simple examples, Variation approach, Elements of variational calculus - Euler Lagrange equation, Rayleigh Ritz method, Weighted Residual methods, Point Collocation method, Galarkin method - Steps involved in FEM.

UNIT-II

Types of Elements Used

Interpolation Polynomials - Linear elements Shape function - Analysis of simply supported beam - Element and Global matrices - Two-dimensional elements, triangular and rectangular elements - Local and Natural Co-ordinate systems.

UNIT-III

Finite Element Formulation of Field Problems

1-D and 2-D heat transfer, fluid flow (incompressible and non-viscous fluid) in ducts, Simple electrical and magnetic field problems. Simple Numerical examples

UNIT-IV

Finite Element Formulation of Solid Mechanics Problems

1-D problem of shaft; Truss element analysis of pinned truss, Plane stress/strain problems, Axi-symmetric problems, thin plate problems; Vibration of shafts & beams.

UNIT-V

Numerical Methods in FEM

Evaluation of shape functions - One dimensional & triangular elements, Quadrilateral elements, Isoperimetric elements - Numerical Integration, Gauss Legendre quadrature -Solution of finite element equations – Gauss Elimination Method, Cholesky decomposition.

Course outcomes

1. Understand various approaches to apply finite element method to solve problems in solid mechanics, fluid mechanics and heat transfer.
2. Use various types of elements and their coordinate systems, shape function, interpolation relation and arrangement of elements in global matrices.
3. Formulate the field problems and solve problems in one dimensional and two dimensional heat transfers, fluid flow, electrical and magnetic field.
4. Formulate finite element characteristic equations for one dimensional element and analyze shaft, vibration of shafts and beams, trusses, plain stress/strain, axi-symmetric and thin plate problems.
5. Apply the numerical methods in FEM and evaluate of shape functions of various elements and solve the finite element equations with various methods for solving real life problems

Books:

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

EME-024: MECHANICAL VIBRATION

Course Objective

1. To know the basics of vibration
2. To study the un-damped and damped free vibration
3. To study the forced vibrations
4. To study the multi degrees of freedom system
5. To study the vibration measuring instruments.

Syllabus-

UNIT - I

Introduction

Periodic motion, harmonic motion, superposition of simple harmonic motions, beats, Fourier analysis **3**

Single Degree Freedom System

Free vibration, Natural frequency, Equivalent systems, Energy method for determining natural frequency, response to an initial disturbance, Tensional vibrations, Damped vibrations, Vibrations of systems with viscous damping, Logarithmic decrement **5**

UNIT - II

Single Degree Freedom: Forced Vibration

Forced vibration, Harmonic excitation with viscous damping, steady state vibrations, Forced vibrations with rotating and reciprocating unbalance, Support excitation, Vibration isolation, Transmissibility, Vibration measuring instruments, Displacement, velocity and acceleration measuring instruments **8**

UNIT- III

Two Degree Freedom systems

Introduction, Principal modes, Double pendulum, Tensional system with damping, coupled system, undamped dynamic vibration absorbers, Centrifugal pendulum absorbers, Dry friction damper **8**

UNIT- IV

Multi Degree Freedom system: Exact Analysis

Undamped free and forced vibrations of multi-degree freedom systems, influence number, Reciprocal theorem, Tensional vibration of multi-degree rotor system, Vibration of gear system, Principal coordinates, Continuous systems- Longitudinal vibrations of bars, Tensional vibrations of circular shafts **8**

UNIT- V

Multi Degree Freedom system: Numerical Analysis

Rayleigh's, Dunkerely's, Holzer's and Stodola methods, Rayleigh-Ritz method **5**

CRITICAL SPEED OF SHAFTS

Shaft with one disc with and without damping, Multi-disc shafts, Secondary critical speed. **3**

Course Outcomes (CO)

Student will be able to

1. Write differential equation of the given vibration model.
2. Know about damping, natural frequency and resonance.
3. Know about response of the vibrating system
4. Know about multi degrees of freedom systems.
5. Know about vibration measurement.

Books and References:

1. Mechanical Vibrations – P. Srinivasan, TMH
2. Mechanical Vibrations – G. K. Groover, Jain Brothers, Roorkee
3. Mechanical Vibrations – W. T. Thomson
4. Mechanical Vibrations – JS Rao & K Gupta, New Age
5. Mechanical Vibrations – Tse, Morse & Hinkle
6. Mechanical Vibrations – V. Rama Murthy, Narosa Publications

EME-062:NON-DESTRUCTIVE TESTING

Course objective

1. To acquire familiarity with different types of NDT techniques
2. To understand the basic principles underlying each NDT technique
3. To know the advantages and limitations of each technique
4. To understand the considerations for selection of appropriate NDT technique(s) for various applications
5. To become familiar with common types of defects arising in different types of manufactured products and the NDT method(s) best suited to evaluate them.

Syllabus

UNIT-1: Introduction

Scope and advantages of NDT. Comparison of NDT with DT. Some common NDT methods used since ages, Terminology. Flaws and Defects, Visual inspection, Equipment used for visual inspection. Ringing test chalk test (oil whitening test). Attractive uses of above tests in detecting surface cracks, bond strength & surface defects. **6**

UNIT-2: Common NDT methods

Die penetrate test (liquid penetrate inspection), Principle, scope. Equipment & techniques, Tests stations, Advantages, types of penetrant and developers. Illustrative examples – Heavy castings of large size, frame of jet engine, porosity testing of nickel alloys, leak testing. Zyglo test **6**

Magnetic particle Inspection – Scope, principle, Ferro Magnetic and Non-ferromagnetic materials, equipment & testing. Advantages, limitations Interpretation of results. DC & AC magnetization, Skin Effect, use of dye & wet powders for magna glow testing, different methods to generate magnetic fields, Applications. **5**

UNIT-3: Radiographic methods

X-ray radiography principle, equipment & methodology. Applicability, types of radiations limitations. Interpretation of Radiographs, limitations of γ -ray radiography – principle, equipment. Attenuation of electro-magnetic radiations, source of radioactive materials & technique. Photo electric effect, Rayleigh's scattering (coherent scattering), Compton's scattering (Incoherent scattering). Pair production, Beam geometry, Scattering factor. Advantages of γ -ray radiography over X-ray radiography Precautions against radiation hazards. Case Study – X-ray of human body. **9**

UNIT-4: Ultrasonic testing methods

Introduction, Principle of operation, Piezoelectricity. Ultrasonic probes, CRO techniques, advantages, Limitation & typical applications. Applications in inspection of castings, forgings,

Extruded steel parts, bars, pipes, rails and dimensions measurements. Case Study – Ultrasonography of human body. **8**

UNIT-5: Eddy Current Inspection

Principle, Methods, Advantages, Scope and limitations. Types of Probes. Case Studies. **4**

Course Outcomes

Student will be able to

1. Develop NDT techniques for various products.
2. Acquire skills needed for selection of appropriate NDT technique(s) for new inspection jobs.
3. Acquire sound knowledge of established NDE techniques and basic familiarity of emerging NDE techniques.
4. Make use of standards and codes in the area of NDET.

Suggested References:

1. ASM Handbook Vol. 11, 8th Edition – Non-destructive Testing & Evaluation
2. Research Techniques in NDT Vol.3, R.S. Shah, Academic
3. Industrial Quality Control, Webstar
4. Bray, Don E. and Stanley, Roderic K., Nondestructive Evaluation: A Tool in Design, Manufacturing, and Service. Revised Edition 1997, CRC Press New York.

EME-751: CAD/CAM LAB

Total ten experiments are to be carried out. Five experiments each from CAD and CAM.

Course Objective-

1. To understand the drawing parameters in design software
2. To understand the design process of various software
3. To understand the pre and post process
4. To learn the FEM

A. CAD Experiments

1. Line Drawing or Circle Drawing experiment: Writing and validation of computer program.
2. Geometric Transformation algorithm experiment for translation/rotation/scaling: Writing and validation of computer program.
3. Design of machine component or other system experiment: Writing and validation of computer program.
4. Understanding and use of any 3-D Modeling Software commands.
5. Pro/E/Idea etc. Experiment: Solid modeling of a machine component
6. Writing a small program for FEM for 2 spring system and validation of program or using a fem Package
7. Root findings or curve fitting experiment: Writing and validation of computer program.
8. Numerical differentiation or numerical integration experiment: Writing and validation of computer program.

B. CAM Experiments

1. To study the characteristic features of CNC machine
2. Part Programming (in word address format) experiment for turning operation (including operations such as grooving and threading) and running on CNC machine
3. Part Programming (in word address format or ATP) experiment for drilling operation (point to point) and running on CNC machine
4. Part Programming (in word address format or ATP) experiment for milling operation (contouring) and running on CNC machine
5. Experiment on Robot and programs
6. Experiment on Transfer line/Material handling
7. Experiment on difference between ordinary and NC machine, study or retrofitting
8. Experiment on study of system devices such as motors and feed-back devices
9. Experiment on Mechatronics and controls

Course Outcomes-

Student will be able to

1. Analyze the geometric transformation matrices, application of Numerical methods in FEM.
2. Sketch various entities using a 3D modelling software like Pro-E/Solid Works/Ansys.
3. Gain elementary knowledge of CNC machine and automation.
4. Understand the manual and computer aided part programming.

EME-752: I.C. ENGINES AND AUTOMOBILE LAB

Course objective-

1. To understand working of various engines
2. To understand the working of accessories of engines
3. To understand the technical specification of a car

Experiments : Say minimum 10 experiments out of following in depth and details.

1. Performance Analysis of Four stroke S.I. Engine- Determination of indicated and brake thermal efficiency, specific fuel consumption at different loads, Energy Balance.
2. Determination of Indicated H.P. of I.C. Engine by Morse Test.
3. Performance Analysis of Four stroke C.I. Engine- Determination of indicated and brake thermal efficiency, specific fuel consumption at different loads, Energy Balance.
4. Study & experiment on Valve mechanism.
5. Study & experiment on Gear Box.
6. Study & experiment on Differential Gear Mechanism of Rear Axle.
7. Study & experiment on Steering Mechanism.
8. Study & experiment on Automobile Braking System.
9. Study & experiment on Chassis and Suspension System.
10. Study & experiment on Ignition system of I.C. Engine.
11. Study & experiment on Fuel Supply System of S.I. Engines- Carburetor, Fuel Injection Pump and MPFI.
12. Study & experiment on Fuel Supply System of C.I. Engines- Injector & Fuel Pump.
13. Study & experiment on Air Conditioning System of an Automobile.
14. Comparative study of technical specifications of common small cars (such as Maruti Swift, Hyundai i20, Cheverlet Aveo, Tata Indica, Ford Fusion etc.
15. Comparative study & technical features of common scooters & motorcycles available in India.
16. Visit of an Automobile factory.
17. Visit to a Modern Automobile Workshop.
18. Experiment on Engine Tuning.
19. Experiment on Exhaust Gas Analysis of an I.C. Engine.

Course Outcome-

Student will be able to

1. Understand the working of various engines.
2. Understand the technical specification of a car.
3. Understand the working of accessories of engines.

EME-031: COMPUTER AIDED MANUFACTURING (CAM)

Course Objective-

1. To understand the basics of CAD/CAM.
2. To gain exposure over the concepts of computer graphics.
3. To learn about the geometric issues concerned to the manufacturing and its related areas.
4. To understand the latest advances in the manufacturing perspectives.

UNIT-I

Automation

Introduction to CAM; Automated Manufacturing system; Need of automation, Basic elements of automation, Levels of automation, Automation Strategies, Advantages &disadvantages of automation, Historical development and future trends. **4**

Features of NC Machines-

Fundamental of Numerical Control, elements of NC machine tools, classification of NC machine tools, Advantages, suitability and limitations of NC machine tools, Application of NC system, Methods for improving Accuracy considering the factors such as tool deflection and chatter and Productivity. **3**

UNIT-II

NC Part Programming-

(a) Manual (word address format) programming. Examples Drilling, Turning and Milling; Canned cycles, Subroutine, and Macro. **5**

(b) APT programming. Geometry, Motion and Additional statements, Macro- statement. **4**

UNIT-III

System Devices

Introduction to DC motors, stepping motors, feedback devices such as encoder, counting devices, digital to analog converter and vice versa. **3**

Interpolators

Digital differential Integrator-Principle of operation, exponential decelarion; DDA Hardware Interpolator- Linear, Circular; DDA Software Interpolator. **4**

Control of NC Systems

Open and closed loops. Control of point to point systems- Incremental open loop control, Incremental close loop, Absolute close loop; Control loop in contouring systems; Adaptive control. **3**

UNIT-IV

Computer Integrated Manufacturing system

Group Technology, Flexible Manufacturing System, CIM, CAD/CAM, Computer aided process planning-Retrieval and Generative, Concept of Mechatronics, Computer aided Inspection. **6**

UNIT-V

Robotics

Types and generations of Robots, Structure and operation of Robot, Robot applications. Economics, Robot programming methods. VAL and AML with examples. **6**

Intelligent Manufacturing

Introduction to Artificial Intelligence for Intelligent manufacturing. **2**

Course Outcome-

Student will be able to

1. To demonstrate the understanding of automation, acquire the knowledge of Numerical Control(NC) and NC machine tools.
2. To generate NC part programming in word address format and APT language.
3. To demonstrate an ability to understand system devices and control of NC systems
4. Acquire knowledge of computer integrated manufacturing systems
5. Understand robotics and intelligent manufacturing.

Books/References-

1. Automation, Production Systems and Computer Integrated Manufacturing by Mikell P. Groover
2. Computer Aided Manufacturing by Kundra and Rao
3. Computer control of Manufacturing systems by Koren
4. NC Machine Tools by S.J. Martin.
5. NC Machines by Koren
6. CAD/CAM by Groover.

EME-043: MECHANICAL SYSTEM DESIGN

Course Objectives-

1. To understand the various types of approaches in Design
2. To understand the analysis, optimization and evaluation method

UNIT-I

Engineering process and System Approach

Basic concepts of systems, Attributes characterizing a system, system types, Application of system concepts in Engineering, Advantages of system approach, Problems concerning systems, Concurrent engineering, A case study-Viscous lubrication system in wire drawing **4**

Problem Formulation

Nature of engineering problems, Need statement, hierarchical nature of systems, hierarchical nature of problem environment, problem scope and constraint, A case study: heating duct insulation system, high speed belt drive system **4**

UNIT-II

System Theories

System Analysis, Black box approach, state theory approach, component integration approach, Decision process approach, A case study- automobile instrumentation panel system. **4**

System modeling

Need of modeling, Model types and purpose, linear systems, mathematical modeling, concepts, A case study compound bar system **4**

UNIT-III

Graph Modeling and Analysis

Graph Modeling and analysis process, path problem, Network flow problem, A case study: Material handling system **4**

Optimization Concepts

Optimization processes, Selection of goals and objectives-criteria, methods of optimization, analytical, combinational, subjective. A case study: aluminum extrusion system. **3**

UNIT-IV

System Evaluation

Feasibility assessment, planning horizon, time value of money, Financial analysis, A case study: Manufacture of maize starch system **4**

Calculus Method for Optimization

Model with one decision variable, model with two decision variables, model with equality constraints, model with inequality constraints, A case study: Optimization of an insulation system.

UNIT-V

Decision Analysis

Elements of a decision problem, decision making, under certainty, uncertainty risk and conflict probability, density function, Expected monetary value, Utility value, Baye's theorem, A case study: Installation of machinery⁴

System Simulation

Simulation concepts, simulation models, computer application in simulation, spreadsheet simulation, Simulation process, problem definition, input model construction and solution, limitation of simulation approach, A case study: Inventory control in production plant ⁵

Course outcomes

Student will be able to

1. Demonstrate the systems approach and problem formulation.
2. Demonstrate the ability to apply system theory and modeling.
3. Apply network technique and optimization concepts to real problems.
4. Apply system evaluation and optimization.
5. Apply decision analysis and simulation to real problems.

Books/References-

1. Design and Planning of Engineering systems-DD Reredith, KV Wong, RW Wood head, and RR Worthman, Prentice Hall Inc., Eaglewood Cliffs, New Jerse
2. Design Engineering-JR Dixon, TMH, New Delhi
3. An Introduction to Engineering Design Method-V Gupta and PN Murthy, TMH, New Delhi
4. Engineering Design-Robert Matousck, Blackie and son ltd. Glasgow
5. Optimization Techniques-SS Rao
6. System Analysis and Project Management-Devid I Cleland, William R King, McGraw Hill.

EME-055 : Six Sigma Methods & Application

L T P
3 1 0

Unit 1

Quality Perception; Quality in Manufacturing, Quality in Service Sector; Differences between Conventional and Six Sigma concept of quality; Six Sigma success stories. Statistical foundation and methods of quality improvement.

Descriptive statistics: Data Type, Mean, Median, Mode, Range, Variation, Standard Deviation, Skewness, Kurtosis.

Probability Distribution: Normal, Binomial, Poisson Distribution

Unit 2

Basics of Six Sigma: Concept of Six Sigma, Defects, DPMO, DPU, Attacks on X'S, Customer focus, Six Sigma for manufacturing, Six Sigma for service. Z score, Understanding Six Sigma organization, Leadership council, Project sponsors and champions, Master Black Belt, Black Belt, Green Belts.

Unit 3

Methodology of Six Sigma, DMAIC, DFSS, Models of Implementation of Six Sigma, Selection of Six Sigma Projects.

Unit 4

Six Sigma Tools: Project Charter, Process mapping, Measurement system analysis, Hypothesis Testing, Quality Function deployment, Failure mode effect analysis, Design of Experiments.

Unit 5

Sustenance of Six Sigma, Communication plan, Company culture, Reinforcement and control, Introduction to softwares for Six Sigma, Understanding Minitab, Graphical analysis of Minitab plots.

Course outcomes

1. Able to explain concept of quality and six sigma concept, utilize the concept of statistics and probability distribution for quality
2. Able to compare six sigma for manufacturing and service sectors, identify defects, understand six sigma organization
3. Determine methods of six sigma, understand selection and implementation model
4. Acquire knowledge on six sigma tools for analysis
5. Understand communication plan, culture and control, acquire knowledge of software for graphical analysis

References:

1. Six Sigma: SPC and TQM in manufacturing and service, Geoff Tennant, Gower Publishing Co.
2. Six Sigma for managers, Greg Brue, TMH
3. What is Six Sigma, Pete Pande, TMH
4. The Six Sigma Way, Peter S. Pande, TMH Team Field book
5. The Six Sigma way, Peter S. Pande, TMH

EME-303

[Following Roll No. to be filled by the candidate]

Roll No.

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B. TECH
THIRD SEMESTER EXAMINATION 2018-19
EME-303
THERMODYNAMICS

Time: 2 Hours

Max. Marks: 50

Note:

- Attempt all questions.
- Assume suitable data, if required. Steam Table/ Mollier chart may be provided.
- All symbols have their usual meanings.

1. Attempt any four questions out of the followings. [4*3=12]

- a. What do you mean by thermodynamic properties? Also, explain the thermodynamic equilibrium. **[CO1]**
- b. A turbine is supplied with steam at a gauge pressure of 1.4 MPa. After expansion in turbine, the steam flows into condenser which is maintained at vacuum of 710 mm Hg. The barometric pressure is 772 mm Hg. Express the inlet and exhaust pressure in Pa. Take density of Hg = $13.6 \times 10^3 \text{ kg/cm}^3$, $g = 9.81 \text{ m/s}^2$. **[CO1]**
- c. Explain the first law of thermodynamics. Also, show that internal energy is a property of the system. **[CO1]**
- d. A stream flowing through the nozzle to increase the velocity of the stream. At the inlet of the nozzle, the fluid conditions are given as, enthalpy = 2500 kJ/kg, velocity = 55 m/s, area = 0.125 m^2 and specific volume = $0.22 \text{ m}^3/\text{kg}$. At the exit, the enthalpy and specific volume are 2250 kJ/kg and $0.59 \text{ m}^3/\text{kg}$, respectively. Calculate the exit velocity, mass flow rate and exit area of the nozzle. Assume no loss of heat in the nozzle and the nozzle is horizontal. **[CO1]**
- e. Differentiate between the heat and work. Also, explain the perpetual motion machine of first kind. **[CO1]**
- f. A fluid is confined in a cylinder by a spring loaded, frictionless piston so that the pressure in a fluid is linear function of the volume ($p=a +bV$). The internal energy of the fluid is given by equation $U=34+3.15pV$, where U in kJ, p in kPa and V in cubic meter. If the fluid changes from an initial state of 170 kPa, 0.03 m^3 to a fluid state of 400 kPa,

0.06 m^3 . Find the direction and magnitude of the work and heat transfer.

[CO1]

2. Attempt any three questions out of the followings.

[3*4=12]

- Explain the second law of thermodynamics with suitable diagrams. Also, show the equivalence of two statements of second law of thermodynamics. [CO2]
- A Carnot cycle operates between two thermal reservoirs, heat source and heat sink at temperatures of T_1 and T_2 ($T_1 > T_2$), respectively. However the temperature of the working fluid is θ_1 and θ_2 where $\theta_1 < T_1$ and $\theta_2 > T_2$. If $T_1 = \theta_1 + kQ_1$ and $T_2 = \theta_2 - kQ_2$ where Q_1 and Q_2 are the amount of heat extracted from heat source and rejected to the sink, respectively and k is a constant. Show that the efficiency of the engine is given by

$$\eta = 1 - \frac{T_2}{T_1 - 2kQ_1} \quad [\text{CO2}]$$

- Show that all heat engines operating between a given constant temperature source and a given constant temperature sink, none has higher efficiency than a reversible engine. [CO2]

- Explain the working of the Carnot heat engine. Also, derive the expression for finding the thermal efficiency of Carnot cycle. [CO2]

3. Attempt any two questions out of the followings.

[2*7=14]

- Explain and derive the Clausius inequality and Clausius theorem. By using the concept of Clausius inequality, show that entropy is the property of the system. [CO3]
- 0.04 m^3 of Nitrogen contained in a cylinder behind a piston is initially at 1.05 bar and 15°C . The gas is compressed isothermally and reversibly until the pressure is 4.8 bar. Calculate: (i) The change of entropy; (ii) The heat flow; (iii) The work done; Sketch the process on a P-V and T-S diagram. Assume nitrogen to act as perfect gas. Molecular weight of Nitrogen = 28, $R = 297 \text{ J/kg-K}$. [CO3]
- Explain the principle of increase of entropy. Also, derive the Maxwell relations and Tds equations. [CO3]

4. Attempt any three questions out of the followings.

[3*4=12]

- Explain the working of four stroke petrol engine. Also, differentiate between four stroke petrol engine and four stroke diesel engine. [CO4]
- The following particulars were obtained in a trial on four stroke gas engine. Duration of trial - 1 hr; revolution - 14000 r.p.m.; number of missed cycles - 500; net brake load - 1470 N; mean effective pressure - 7.5 bar; gas consumption - 20000 liters; calorific

values of fuel – 21 kJ/liter; cylinder dia. – 250 mm; stroke – 400 mm; effective brake circumference – 4m; compression ratio – 6.5. Calculate the indicated horse power, brake horse power, mechanical efficiency, indicated thermal efficiency and relative thermal efficiency. [CO4]

- c. Explain the p-v diagram for the generation of steam from -10°C ice to 250°C steam. Calculate the enthalpy and entropy of steam when the pressure is 2MPa and specific volume is $0.09\text{ m}^3/\text{kg}$. [CO4]

- d. Draw the T-S and h-s diagram for the generation of steam from -5°C ice to 250°C steam. Also, calculate the change in entropy for different stages during the generation of steam. Take C_p of water = 4187 kJ/kgK, C_p of steam = 1.093 kJ/kgK, C_p of ice = 2.093 kJ/kgK, latent heat of fusion of ice = 334.96 kJ/kg and latent heat of vaporization = 2257 kJ/kg [CO4]

***** End *****