Education

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(ESTABLISHED BY MINISTRY OF HUMAN RESOURCE DEVELOPMENT, GOVT. OF INDIA)

Ethics

In GOD's own land, a fusion of scholastic students, innovative & motivated researchers & teachers and fast moving visionary leaders.

Steeping Stone and Sky reaching ladder to success

COURSE STRUCTURE & SYLLABUS
FOR
MECHANICAL ENGINEERING

Research

PO- Yupia, Dist. – Papum Pare, Arunachal Pradesh, Pin – 791 112
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Service to Society

NATIONAL INSTITUTE OF TECHNOLOGY

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284972, E-mail: nitarunachal@gmail.com

Department of Mechanical Engineering

Prof. (Dr.) Chandan Tilak Bhunia, Ph.D [Engg.], FIETE, FIE (I), SMIEEE

DIRECTOR

FOREWORD

To **achieve the target of being a global leader in the field of Technical Education**, there is some sort of time bound urgency **to work quickly, massively and strongly**, in respect of National Institute of Technology, Arunachal Pradesh being an **" Institute of National Importance"** (by an Act of Parliament) and being **established only in five years back in 2010**. I have therefore adopted a **'B' plan** as stated below to achieve the primary goal of producing world class visionary engineers and exceptionally brilliant Researchers and Innovators:

<div style="border:1px solid">

B- Plan

- ➤ **Best Teaching**
- ➤ **Best Research**
- ➤ **Best Entrepreneurship & Innovation practices**
- ➤ **Best Services to Society**

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In implementing the **'B' plan** in letter and spirit, the framing of syllabi has been taken **as an important legitimate parameter**. Therefore, extraordinary **efforts and dedications were directed for the last few years to frame** syllabi **in a framework which is perhaps not available in the country as of today, with an Indian perspective in a Global context**.

Besides attention on **'B' plan** institute has given considerable importance to the major **faults of current Technical Education while framing the syllabus**. The major stumbling blocks in Technical Education today are:

I. The **present system is producing "Academic Engineers" rather than "Practical Engineers".**
II. The present system of education makes the **students to run after jobs rather than making them competent to create jobs.**
III. There is lack of **initiative to implement the reality of "Imagination is more important than knowledge".**

Taking due consideration of the findings made above, to my mind credible syllabi has been framed in the institute in which the major innovations are introduction of:

I. **I-Course (Industrial Course) one in each semester at least one, which is targeted to be taught by the Industrial Expert at least up to 50% of its component.**

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II. **Man making and service to society oriented compulsory credit courses of NCC/NSS, values & ethics.**

III. **Compulsory audit course on Entrepreneurship for all branches.**

IV. **Many add-on courses that are (non-credit courses) to be offered in vacation to enhance the employability of the students.**

V. **Many audit courses like French, German, and Chinese to enhance the communication skill in global scale for the students.**

VI. **Research and imagination building courses such as Research Paper Communication.**

VII. **Design Course as "Creative Design".**

Further, the syllabi are framed **not to fit in a given structure as we believe structure is for syllabus and syllabus is not for structure. Therefore, as per requirement of the courses, the structure, the credit and the contact hours have been made available** in case to case.

The syllabus is also innovative as it includes:

I. **In addition to the list of text and reference books, a list of journals and magazines for giving students a flexibility of open learning.**

II. **System of examination in each course is conventional examination, open book examination and online examination.**

Each course has been framed with definite objectives and learning outcomes. The Syllabus has also identified the courses to be taught either of two models of teaching:

I. **J. C. Bose model of teaching where practice is the first theory.**

II. **S. N. Bose model of teaching where theory is the first practice.**

Besides the National Institute of Technology, Arunachal Pradesh has initiated a scheme of **simple and best teaching** in which for example:

I. **Instead of teaching RL, RC and RLC circuit separately, only RLC circuit will be taught and with given conditions on RLC circuits, RL and RC circuits will be derived and left to the students as interest building exercise.**

II. **Instead of teaching separately High Pass Filter, Band Pass Filter and Low Pass Filter etc.; one circuit will be taught to derive out other circuits, on conditions by the students.**

I am firmly confident that the framed syllabus will result in **incredible achievements, accelerated growth and pretty emphatic win over any other systems** and therefore **my students will not run after jobs rather jobs will run after them.**

For the framing of this excellent piece of syllabus, **I like to congratulate all members of faculty, Deans and HODs in no other terms but "Sabash!".**

Prof. Dr. C.T. Bhunia
Director, NIT, (A.P.)

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TEACHING GUIDELINES

In order to achieve the desired goal of excellence and innovations in each and every function of National Institute of Technology, Arunachal Pradesh and to implement 'B' Plan in totality, I call upon my distinguished members of Faculty to invest some of their valuable business time in doing Research on Teaching. In this context, I put forward the following general guidelines for teaching practices in the institute:

1) **J.C. Bose Model of Teaching:** As an example, In the Basic Electronics course instead of first teaching the colour codes of the resistors in a theoretical class, teacher may carry few resistors to class and note down on the blackboard the colours of resistors and their values. Thereafter, the teacher may ask the students to device the color code creating enthusiasm among students. Similarly, instead of teaching the characteristics of PN junction diode, teacher may guide the students in a laboratory to draw the characteristics curve, then may advise the students to analyse the behaviour of characteristics. Thereafter, the teacher may teach the theory of PN junction diode.

2) **S.N. Bose Model of Teaching:** This is the conventional model of teaching where theory is first practice but even then I suggest some unique ideas to improve imaginative power and creativity of students in the subject. For example, instead of teaching two algorithms for conversion of decimal to binary, one for integral part and another for fractional part, I call upon the teachers to design a single algorithm for both the purposes for inspiring teaching.

3) I also believe that noble teaching **will be simple and in simpler way.** Therefore, I call upon the teachers not to teach band-pass filter, low pass filter, high pass filter separately. Teachers may design a single circuit for all filters and put on condition thereon can derive separately circuits for separate filters. Similarly, instead of teaching RL, RC and RLC circuits separately, I call upon the teachers to teach only RLC circuit and then putting suitable condition on RLC circuit; RL and RC circuits may be derived and taught.

4) **Last but not the least,** I call upon the teachers to **solve all the problems of all chapters of the main text book prescribed for a subject** in a teaching-learning process – 50% to be solved by teachers (may be of even ones) and 50% may be solved by students (may be odd ones).

I solicit and anticipate full cooperation from all my brilliant pool of young and energetic faculty members to practice the noble and novel teaching procedures explained above without fail. Once **procedures implemented by teachers are documented,** we may proceed to file a patent on **Research in Teaching on behalf of NIT, Arunachal Pradesh.**

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Director, NIT, (A.P.)

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Mechanical Engineering is one of the major engineering divisions. Its principles are involved in the design, development and construction of nearly all of the physical devices and systems that modern technology has produced. Mechanical engineers are also concerned with the operations of all kinds of machineries, and the production of power. They must conceive research, design, develop, test, manufacture and sell equipment for these purposes. . It is one of the oldest and broadest engineering disciplines.

The Department of Mechanical Engineering at National Institute of Technology, Arunachal Pradesh was established in August 2013. The department offers four year degree B.Tech in Mechanical Engineering with an annual intake of 30 students. Within a very short period this Department already developed some New Laboratories with modern art of facilities. A continuous effort is always on towards setting up new laboratories and improvement of facilities in the existing laboratories.

Our objective is to provide students with a quality mechanical engineering education, enhance the understanding and application of mechanical engineering principles, imparting knowledge with imagination for techno economical development of the country, and improving the quality of life of our citizens through teaching, research, and innovation. The mission is further to provide an environment where students will get extensive avenues to excel, improve technical exposure and develop personality and then get recruited in reputed organizations with global presence, in various roles and responsibilities and also to meet the mission of Arunachal Pradesh, North East region and the nation at large.

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Summary Table of Different Courses

Semester	Credit Course	I- Course	Audit Course	Add-on course
1st	Engineering Mathematics I Engineering Chemistry Engineering Physics I Life Science Engineering Mechanics Engineering Drawing Workshop Practice I Basic Electrical & Electronics Engineering Communication Skill	**NIL**	NSS/ NCC Foreign Language (French/ Korean)	**NIL**
2nd	Engineering Mathematics II Engineering Physics II Environmental Science Basic Mechanical Engineering Programming in C Workshop Practice II Digital Electronics & Logic Design Historiography of Science & Technology Basic Civil Engineering	**NIL**	Foreign Language (German/ Chinese)	**NIL**
3rd	Engineering Mathematics III Basic Thermodynamics Material Sciences & Engineering Strength of Materials Workshop Practice III Behavioural Science	Fluid Mechanics I	**NIL**	**NIL**
4th	Stochastic Processes Applied Thermodynamics Fluid Mechanics II Electrical Machines Machine Drawing Theory of Machines	Engineering Materials and Processes	**NIL**	**Auto CAD/ CAM**
5th	Machine Design I Heat Transfer Measurement and Metrology Manufacturing Technology Industrial Engineering & Management	Internal Combustion Engines	**NIL**	**ANSYS/ PRO E**
6th	Engineering Ethics & IPR Disaster Management Dynamics of Machinery Machine Design II Numerical Methods in Engineering	Power Plant Engineering Automation and Computerized Manufacturing	**NIL**	**MATLAB+LABVIEW/ C++**
7th	Research Paper	Refrigeration	**NIL**	**FORTRAN**

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	Communication Mass Communication for Technology Creative Design Elective I (Dept.) Elective II (Dept.) Project & Thesis Preliminary	and Air-Conditioning Green Car Technology		
8th	Project, Thesis & Viva Grand Viva Seminar & Group Discussion Industrial Training	**NIL**	**NIL**	**NIL**

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Examination System

Semester	Conventional	Open Book	Online
1st	Engineering Chemistry Life Science Engineering Mechanics Engineering Drawing I Workshop Practice I Communication Skill NSS/ NCC Foreign Language (French/ Korean)	Engineering Mathematics I Engineering Physics I Basic Electrical & Electronics Engineering	NIL
2nd	Engineering Mathematics II Basic Mechanical Engineering Workshop Practice II Basic Civil Engineering Environmental Science Engineering Physics II Digital Electronics & Logic Design Historiography of Science & Technology Foreign Language (German/ Chinese)	Programming in C	NIL
3rd	Engineering Mathematics III Basic Thermodynamics Material Sciences & Engineering Fluid Mechanics I Workshop Practice III Behavioural Science	Strength of Materials	NIL
4th	Stochastic Processes Applied Thermodynamics Engineering Materials and Processes Fluid Mechanics II Machine Drawing Entrepreneurship and Innovation	Theory of Machines	NIL
5th	Internal Combustion Engines Heat Transfer Measurement and Metrology Manufacturing Technology Industrial Engineering & Management Electrical Machines	Machine Design I	NIL

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6th	Dynamics of Machinery Power Plant Engineering Automation and Computerized Manufacturing Engineering Ethics & IPR Disaster Management	Machine Design II	Numerical Methods in Engineering
7th	Refrigeration and Air-Conditioning Elective I (Dept.) Elective II (Dept.) Mass Communication for Technology Research Paper Communication Project & Thesis Preliminary	Creative Design Green Car Technology	NIL
8th	Project, Thesis & Viva Grand Viva Seminar and Group Discussion Industrial Training	NIL	NIL

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FIRST SEMESTER

Subject Code	Subject	Model	P	T	L	Credit
MAS 101	Engineering Mathematics I	SNB	0	1	3	4
CHY 101	Engineering Chemistry	SNB	2	0	3	4
PHY 101	Engineering Physics I	SNB	2	0	3	4
BIO 101	Life Science	SNB	0	0	3	3
CE 101	Engineering Drawing	JCB	3	0	0	2
ME 101	Engineering Mechanics	SNB	0	0	3	3
ME 102	Workshop Practice I	JCB	3	0	0	2
EE 101	Basic Electrical & Electronics Engineering	JCB	2	0	3	4
HSS 101	Communication Skill	SNB	2	0	0	1
HSS 102	NSS / NCC	JCB	2	0	0	1
HSS 103	Foreign Language (French / Korean) (Audit)	JCB	2	0	0	0
	Total		**18**	**1**	**18**	**28**

SECOND SEMESTER

Subject Code	Subject	Model	P	T	L	Credit
MAS 201	Engineering Mathematics II	SNB	0	1	3	4
ME 201	Basic Elements of Mechanical Engineering	SNB	0	0	3	3
CSE 201	Programming in C	JCB	8	0	0	4
CHY 201	Environmental Science	JCB	0	0	3	3
PHY 201	Engineering Physics II	SNB	2	0	3	4
ECE 201	Digital Electronics & Logic Design	JCB	2	0	3	4
HSS 201	Historiography of Science & Technology	JCB	0	0	3	3
CE 201	Basic Civil Engineering	JCB	0	0	3	3
ME 202	Workshop Practice II	JCB	3	0	0	2
HSS 202	Foreign Language (German / Chinese) (Audit)	JCB	2	0	0	0
	Total		**17**	**1**	**21**	**30**

THRD SEMESTER

Subject Code	Subject	Model	P	T	L	Credit
MAS 311	Engineering Mathematics III	SNB	0	1	3	4
ME 301	Basic Thermodynamics	SNB	2	1	3	5
ME 302	Material Sciences & Engineering	SNB	0	0	3	3
ME 303	Strength of Materials	SNB	3	0	3	5
ME 304	Fluid Mechanics I	SNB	3	0	3	5
ME 351	Workshop Practice III	JCB	3	0	0	2
HSS 301	Behavioural Science	SNB	0	0	2	2
HSS 302	Yoga	JCB	2	0	0	1
	Total		**13**	**2**	**17**	**27**

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FOURTH SEMESTER

Subject Code	Subject	Model	P	T	L	Credit
MAS 401	Stochastic Process	SNB	0	1	3	4
EE 400	Electrical Machines	SNB	3	0	3	5
ME 401	Applied Thermodynamics	SNB	0	1	3	4
ME 402	Engineering Materials and Processes	JCB	3	0	3	5
ME 403	Fluid Mechanics II	SNB	3	0	3	5
ME 404	Theory of Machines	SNB	0	0	3	3
ME 451	Machine Drawing	JCB	3	0	0	2
HSS 401	Entrepreneurship and Innovation	SNB	0	0	3	3
	Total		**12**	**2**	**21**	**31**

FIFTH SEMESTER

Subject Code	Subject	Model	P	T	L	Credit
ME 501	Machine Design I	SNB	3	0	3	5
ME 502	Internal Combustion Engines	SNB	3	0	3	5
ME 503	Heat Transfer	SNB	2	0	4	5
ME 504	Measurement and Metrology	JCB	2	0	3	4
ME 505	Manufacturing Technology	JCB	3	0	3	5
ME 506	Industrial Engineering & Management	SNB	0	0	3	3
	Total		**13**	**0**	**19**	**27**

SIXTH SEMESTER

Subject Code	Subject	Model	P	T	L	Credit
ME 601	Dynamics of Machinery	SNB	3	0	3	5
ME 602	Machine Design II	SNB	2	0	3	4
ME 603	Power Plant Engineering	SNB	2	0	3	4
ME 604	Automation and Computerized Manufacturing	JCB	3	0	3	5
MAS 602	Numerical Methods in Engineering	SNB	2	0	3	4
HSS 601	Engineering Ethics & IPR	JCB	0	0	3	3
HSS 602	Disaster Management	JCB	0	0	2	2
	Total		**12**	**0**	**20**	**27**

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SEVENTH SEMESTER

Subject Code	Subject	Model	P	T	L	Credit
HSS 701	Mass Communication for Technology	JCB	0	0	3	3
HSS 702	Research Paper Communication	JCB	2	0	0	1
ME 701	Refrigeration and Air-Conditioning	SNB	3	0	3	5
ME 702	Creative Design	SNB	0	0	2	2
ME 703/E I	Elective I (Dept.)	SNB	0	0	3	3
ME 704/E II	Elective II (Dept.)	SNB	0	0	3	3
ME 705	Green Car Technology	JCB	2	0	2	3
ME 751	Project & Thesis Preliminary	JCB	1	0	0	4
	Total		**8**	**0**	**16**	**24**

EIGHT SEMESTER

Subject Code	Subject	Model	P	T	L	Credit
ME 852	Project & Thesis	JCB	0	0	0	8
ME 853	Grand Viva	JCB	0	0	0	4
ME 854	Seminar and Group Discussion	JCB	1	0	0	2
ME 855	Industrial Training	JCB	1	0	0	2
			2	**0**	**0**	**16**

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Department of Mechanical Engineering

SEMESTER-I
(Common to all Branches)

Name of the Module: Engineering Mathematics I
Module Code: MAS 101
Semester: 1st
Credit Value: 4 [P=0, T=1, L=3]

A. Objectives:
The course is designed to meet with the following objectives:
1. Providing high quality education in pure and applied mathematics in order to prepare students for graduate studies or professional careers in mathematical sciences and related fields.
2. Imparting theoretical knowledge and to develop computing skill to the students in the area of Science and Technology.
3. Providing teaching and learning to make the students competent to their calculating ability, logical ability and decision making ability.
4. Giving students theoretical knowledge of Calculus, Algebra and their practical applications in the various fields of Science and Engineering.
5. Apply their knowledge in modern industry or teaching, or secure acceptance in high-quality graduate programs in Mathematics and other fields such as the field of quantitative/Mathematical finance, Mathematical computing, statistics and actuarial science.

B. Learning Outcomes:
Students successfully completing this module will be able to:
1. Become more confident about their computing skill, logical skill and decision making skill.
2. Find various applications of Calculus and Algebra in the practical field's science and engineering.
3. Become more competent to analyse mathematical and statistical problems, precisely define the key terms, and draw clear and reasonable conclusions.
4. Use mathematical and statistical techniques to solve well defined problems and present their mathematical work, both in oral and written format, to various audiences (students, mathematicians, and non-mathematicians).
5. Understand, and construct correct mathematical and statistical proofs and use the library and electronic data-bases to locate information on mathematical problems.
6. Explain the importance of Mathematics and its techniques to solve real life problems and provide the limitations of such techniques and the validity of the results.
7. Propose new mathematical and statistical questions and suggest possible software packages and/or computer programming to find solutions to these questions.

C. Subject Matter:
Unit I:
Matrices: Introduction to Matrices and their basic properties, Transpose of a matrix, verification of the properties of transposes, Symmetric and Skew symmetric matrices and their properties. Determinant of a square matrix, Minors and Cofactors, Laplace's method of expansion of a determinant, Product of determinants, Adjoint of a determinant, Jacobi's theorem on adjoint determinant. Singular and non-

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Singular matrices, Adjoint of a matrix, Inverse of a non-singular matrix and its properties, Orthogonal matrix and its properties, Trace of a matrix, Rank of a matrix and its determination using elementary row and column operations, Solution of simultaneous linear equations by matrix inversion method, Consistency and inconsistency of a system of homogeneous and non homogeneous linear simultaneous equations, Eigen values and Eigen vectors of a square matrix (of order 2 or 3), Eigen values, Caley-Hamilton theorem and its applications, Diagonalisation of a square matrix with real and distinct eigen values (up to 3rd order).

Unit II:

 Successive Differentiation: Higher order derivatives of a function of single variable, Leibnitz's theorem (statementonly) and its application, problems of the type of recurrence relations in derivatives of different orders.

 Mean Value Theorems & Expansion of Functions: Rolle's theorem(statement only) and its application, Mean Value theorems – Lagrange & Cauchy (statement only) and their application, Taylor's theorem with Lagrange's and Cauchy's form of remainders (statement only) and its application, Expansions of functions by Taylor's and Maclaurin's theorem, Maclaurin's infinite series expansion of the functions.

Unit III:

 Integrals: Double and triple integrals and evaluation of area and volume. Change of order of integration.

 Reduction formula: Reduction formulae both for indefinite and definite integrals.

Unit IV

 Complex variables: complex numbers, De-Moivre's Theorem and its applications, Inverse circular and Hyperbolic functions, functions, continuity, Differentiability,   analyticity -Cauchy Riemann equations and properties of ana1ytic functions, Cauchy's integral and Cauchy's integral formula, derivatives of analytic functions.

D. Teaching/ Learning/ Practice Pattern:

> Teaching: 70%
> Learning: 30%
> Practice: 0%

E. Examination Pattern:

> Theoretical Examination: Written

F. Reading Lists:

Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th edition Wiley Eastern.
2. Babu Ram, "Engineering Mathematics", 1st edition, Pearson Education.
3. H. K. Dass "Higher Engineering Mathematics", 43rd edition S. Chand & Co.
4. B.S. Grewal , "Engineering Mathematics", S. Chand & Co.
5. PulakKundu, "A Text book on Engineering Mathematics" Vol. I, ChhayaPrakashani.
6. Pal &Das, "Engineering Mathematics" Vol. I, U.N. Dhar.
7. John Bird, "Higher Engineering Mathematics",4th Edition, 1st Indian Reprint 2006, Elsevier.
8. L. Rade and B. Westergren, "Mathematics Handbook: for Science and Engineering", (5th edition, Indian Edition 2009, Springer).
9. M. J. Strauss, G. L. Bradley and K. L. Smith , "Calculus", 3rd Edition, 1st Indian Edition 2007, Pearson Education.
10. S. K. Adhikari, "A text Book of Engineering Mathematics-I", Dhanpat Rai and Co. (P) Ltd.
11. S. S. Sastry, "Engineering Mathematics", PHI, 4th Edition, 2008.

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12. Ravish R Singh, *"Engineering Mathematics"*, McGraw Hill.
13. Das & Mukherjee, *"Differential Calculus"*, U.N. Dhar& Sons Private Ltd.
14. Das & Mukherjee, *"Integral Calculus"*, U.N. Dhar& Sons Private Ltd.

Magazines:
1. *Current Science (Indian Academy of Science).*
2. *The Mathematics Student (Math Student) (Indian Mathematical Society).*
3. *Mathematical Spectrum (The University of Sheffield).*
4. *Mathematics Magazine (Mathematical Association of America).*
5. *+Plus magazine (University of Cambridge).*
6. *Mathematics Today, London Metropolitan University.*

Journals:
1. *Journal of Engineering Mathematics, Springer.*
2. *Journal of Computational and Applied Mathematics, London Metropolitan University.*
3. *The Journal of Indian academy of Sciences.*
4. *Bulletin of Pure and Applied Sciences.*

Name of the Module: Engineering Chemistry
Module Code: CHY 101
Semester: 1st
Credit Value: 4 [P=2, T=0, L=3]

A. Objectives:
The course is designed to meet with the following objectives:
1. Imparting theoretical and practical knowledge to the students in the area of Chemistry.
2. Providing teaching and learning to make students acquainting with advanced science and technology in Chemistry.
3. Injecting the future scope and the research direction in the discipline of Chemistry.
4. Making students competent to the research and development in advanced science and technology in Chemistry.

B. Learning outcomes:
Students successfully completing this module will be able to:
1. Adequately trained to become Chemists, Scientist and Chemical Engineers.
2. Skilled both theoretically and practically to do operation, control and maintenance works in Chemistry and Chemical Engineering.
3. Substantially prepared to take up prospective research assignments.

C. Subject matter:
Unit I:

Chemical Thermodynamics: Concept of Thermodynamic System: diathermal wall, adiabatic wall, isolated system, closed system, open system, extensive property, intensive property. Introduction to first law of thermodynamics: different statements, mathematical form; internal energy: physical significance, mathematical expression (ideal and real gas), Enthalpy: physical significance, mathematical expression. Cp and CV definition and relation; adiabatic changes; reversible and irreversible processes; application of first law of thermodynamics to chemical processes: exothermic, endothermic processes, law of Lovoisier and Laplace, Hess's law of constant heat summation,

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Kirchoff's law. Second law thermodynamics; Joule Thomson and throttling processes; inversion temperature; evaluation of entropy: characteristics and expression, entropy change in irreversible process, entropy change for irreversible isothermal expression of an ideal gas, entropy change of a mixture of gases.

Work function and free energy: physical significance, mathematical expression for ideal and real gases obeying Vander Waals' equation, Gibbs Helmholtz equation.

Condition of spontaneity and equilibrium

Unit II:

Electrochemistry Conductance: Conductance of electrolytic solutions, specific conductance, equivalent conductance, molar conductance and ion conductance, effect of temperature and concentration, Kohlrausch's law of independent migration of ions, transport numbers and hydration of ions, Conductometric titrations: SA vs SB & SA vs WB, precipitation titration KCl vs AgNO3.

Electrochemical cell: Cell EMF and its Thermodynamic significance, single electrode potentials and its applications; hydrogen half cell, quinhydrone half cell and calomel half cell. Storage cell, fuel cell. Application of EMF measurement, Reaction Dynamics: Reaction laws: rate and order; molecularity; zero, first and second order kinetics, Arrhenius equation, Mechanism and theories of reaction rates (Transition state theory, Collision theory).Catalysis: Homogeneous catalysis and heterogeneous catalysis.

Unit III:

Structure and reactivity of Organic molecule: Electro negativity, electron affinity, hybridization, Inductive effect, resonance, hyper conjugation, electromeric effect, carbocation, carbanion and free radicals. Brief study of substitution, eliminations and addition reactions, **Instrumental Methods of Analysis:** Introduction to instrumental methods such as IR, UV, VIS, NMR and Mass spectrometry.

Unit IV:

Polymerization: Concepts, classifications and industrial applications, Polymerization processes (addition and condensation polymerization), degree of polymerization, Co-polymerization, stereo-regularity of polymer, crystallinity and amorphicity of polymer, Preparation, structure and use of some common polymers: plastic (PE, PP, PVC, bakelite), rubber (natural rubber, SBR, NBR), fibre (nylon 6.6, polyester), Conducting and semi-conducting polymers.

Industrial Chemistry: Solid, liquid and gases fuels; constituents of coal, carbonization of coal. Coal analysis: Proximate and ultimate analysis. Classification of coal, petroleum (LPG, CNG), gasoline, octane number, aviation fuel, diesel, cetane number. Natural gas, water gas, Coal gas, bio gas. Bio-diesel.

D. List of practicals: (Minimum eight experiments should be conducted by students)

1. Acid base titration :(Estimation of commercial caustic soda)
2. Red-ox titration: (Estimation of iron using permanganometry)
3. Complexometric titration: (Estimation of hardness of water using EDTA titration)
4. Chemical Kinetics :(Determination of relative rates of reaction of iodide with hydrogen peroxide at room temperature (clock reaction).
5. Heterogeneous equilibrium (Determination of partition coefficient of acetic acid between n-butanol and water)
6. Viscosity of solutions (determination of percentage composition of sugar solution from viscosity)
7. Conductometric titration for
   (a)Determination of the strength of a given HCl solution by titration against a standard NaOH solution.
   (b) Analysis of a mixture of strong and weak acid by strong base.
8. Preparation of a homo-polymer by free radical initiated chain polymerization and determination of its molecular weight by viscosity average molecular weight method.
9. pH- metric titration for determination of strength of a given HCl solution against a standard NaOH.

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Department of Mechanical Engineering

E. Teaching/ Learning/ Practice pattern:

        Teaching: 40%

        Learning: 10%

        Practice: 50%

F. Examination pattern:
1. Theoretical Examination: Written.
2. Practical Examination: Conduct Practical Examination and viva-voce.

G. Reading lists:
Books:
1. *Rakshit P. C., "Physical Chemistry"7th edition Sarat Book Distributor.*
2. *Dutta R. L.,"Inorganic Chemistry" The New Book Stall.*
3. *Levine" Physical Chemistry" 6th edition, McGraw-Hill Education.*
4. *Finar I. L., "Organic Chemistry (vol. 1 & 2)."6th edition, Pearson.*
5. *lasston Samuel, " Text Book of Physical Chemistry" New York, D. Van Nostrand company.*
6. *Lee J. D., "Concise Inorganic Chemistry"5th edition Wiley India.*
7. *Sykes,P., "Guidebook to Mechanism in Org.Chems", 6th edition ,Orient Longman.*
8. *Chakraborty D.K., "Solid State Chemistry",2nd edition New Age International.*
9. *Gupta M.C., "Atomic & Molecular Spectroscopy",1st edition, New Age.*
10. *Gowarikar V.R., "Polymer Science", 1st edition New Age.*
11. *Mishra G.S., "Introductory Polymer Chemistry", New Age.*
12. *Nasipuri D.,"Stereochemistry of Organic Compounds", 4th rev edition, New Age.*
13. *Kalsi P.S, "Spectroscopy of Organic Compounds", 6th edition, New Age.*
14. *Kalsi P.S.,"Organic Reactions & their Mechanism", 3rd edition, New Age.*
15. *Maity and Maity ," Engingeering Chemistry",U & N Dhar Publisher.*
16. *Ray, Das, Biswas, "Engingeering Chemistry", 1st edition, New Central Book Agency.*

Magazine:
1. *Chemical Science.*
2. *Chemistry Today.*
3. *Chemistry for You.*

Journals:
1. *Journal of Organic Chemistry, ACS.*
2. *Journal of Physical Chemistry, ACS.*
3. *Material Science & Engineering B, Elsevier.*

Name of the Module: Engineering Physics I
Module Code: PHY 101
Semester: 1st
Credit Value: 4 [P=2, T=0, L=3]

A. Objectives:
The course is designed to meet with the following objectives:
1. Imparting theoretical & practical knowledge to the students in the area of Engineering Physics.
2. Providing teaching and learning to make students acquainting with modern state-of-art of

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Department of Mechanical Engineering

Engineering.

3. Injecting the future scope and the research direction in the field of Physics with specific specialization.
4. Making students competent to design & development of Engineering Physics.

B. Learning outcomes:
Students successfully completing this module will be able to:
1. Adequately trained to become Engineers.
2. Substantially prepared to take up prospective research assignments.

C. Subject matter:
Unit I:
Scalar and vector: Scalar and vector, dot and cross product, Scalar and vector fields, concept of Gradient, Divergence and Curl.

General Properties of Matter: Elasticity, Viscosity, Surface tension.

Unit II:
Acoustics: Simple Harmonic Motion, Damped Vibration, Forced Vibration.

Thermal Physics: Kinetic Theory of Gas, conductivity & Radiation.

Unit III:
Physical Optics: Introduction to Interference, Diffraction, Polarization.

Elementary Solid State Physics: Elementary ideas of crystal structure : lattice, basis, UNIT cell, fundamental types of lattices-Bravis lattice, simple cubic, f.c.c and b.c.c lattices, Miller indices and miller planes, Co-ordination number and atomic packing factor, X-rays: Origin of characteristics and continuous X-ray, Bragg's law (no derivation), determination of lattice constant.

Unit IV:
Fundamental of Quantum Physics: Wave particle duality, Compton effect, Photo electric effect, Heisenberg's uncertainty relation, concept of wave packet.

D. List of practicals: (Minimum five experiments should be conducted by students)
1. Determination of thermal conductivity of a good conductor by searle's method.
2. Determination of thermal conductivity of a bad conductor by Lees and Chorlton's method.
3. Determination the dispersive power of the material of a given prism.
4. Use of carry Foster's bridge to determine unknown resistance.
5. Determination of Young Modulus by flexure method and calculation of bending moment and shear force at a point on the beam.
6. Determination of coefficient of Viscosity by Poiseulle's capillary flow method.
7. Determination of wavelength of light by Newton's ring method.

E. Teaching/ Learning/ Practice pattern:
Teaching: 40%

Learning: 10%

Practice: 50%

F. Examination pattern:
1. Theoretical Examination: Written.
2. Practical Examination: Conduct Practical Examination and viva-voce.

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G. Reading lists:

Books:

1. Murrat R. Spiegel, Seymour Lipschutz& Dennis Spellman, "Vector Analysis" Second Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2009.
2. Takwale and Puranic, "Classical Mechanics"1st edition , Tata McGraw-Hill Publishing
3. Sengupta&Chatterjeee, "A Treatise on General Properties of Matter " New Central Book Agency (P) Limited
4. D. Chattopadhyay and P. C. Rakshit, "Vibrations, Waves and Acoustics" Books and Allied (P) Ltd.
5. N. K. Bajaj, "The physics of Waves and Oscillations" Tata McGraw Hill Education Private Limited, New Delhi.
6. A. Ghatak, "Optics" 4th Edition, Tata McGraw Hill Education Private Limited, New Delhi.
7. S. O. Pillai, "Solid State Physics", Wiley Eastern Ltd.
8. Kittel, "Solid State Physics" 7th edition, Wiley India.
9. Richard P. Feynman, Robert B. Leighton and Matthew Sands, "The FEYNMAN Lectures on Physics" Vol. I to Vol. IV, Pearson
10. D. Chattopadhyay and P. C. Rakshit, "An Advanced Course in Practical Physics" 8th edition, New Central Book Agency (P) Ltd.

Magazine:

1. Physics Reports.
2. Quarterly Reviews of Biophysics.
3. Resonance.
4. American Teacher.
5. Scientific Physics.
6. Physics Today.
7. Physics for You.

Journals:

1. Nature
2. Physical Review Letter
3. Physical Review A & B
4. Applied Physics Letters (APL)
5. Proceedings of the National Academy of Sciences
6. Chemical Physics Letters
7. Journal of Physics: (Including A, B, C, D, E, F & G) 8. Journal of Scientific & Industrial Research
8. Indian Journal of Engineering & Material Sciences
9. Indian Journal of Radio and Space Physics.

Name of the Module: Life Science
Module Code: BIO 101
Semester: 1st
Credit Value: 3 [P=0, T=0, L=3]

A. Objectives:
The course is design to meet with the following objectives:

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1. Imparting knowledge on the origin of Earth and life forms on Earth, appreciating importance of biological diversity and understanding bio molecules being the main component of life.
2. Understanding "Cell" the basic unit in different life forms, and structure and function of different tissue systems in plants and animals.
3. Imparting knowledge on water relations, nutrient uptake and assimilation, and metabolism in plants.
4. Providing knowledge on Bioenergetics of plant and animal cells, different organelles involved in electron transport systems, nervous, digestive and immune systems in animals.

B. Learning Outcomes:

Upon completion of the subject, students will be able to:

1. Understand the characteristics of living organisms; appreciate the importance of diversity of life and their interaction with the environment.
2. Explain the interrelationship between bio molecules and the living system, and influences of bio-molecules upon the structure and function of intracellular components.
3. Have a broad knowledge on Bioenergetics of plant and animal cells; and a brief on important biological systems of animal.

C. Subject Matter:

Unit I:

Origin of Life: History of earth, theories of origin of life and nature of the earliest organisms.

Varieties of life: Classification, Five kingdoms, viruses (TMV, HIV, Bacteriophage), Prokaryote (Bacteria-cell structure, nutrition, reproduction), Protista, Fungi, Plantae and Animalia.

Chemicals of life: (Bio molecules) Carbohydrates lipids, amino acids, proteins, nucleic acids and identification of bio molecules in tissues.

Unit II:

Cell: Cell concept, structure of prokaryotic and eukaryotic cells, plant cells and animal cells, cell membranes, cellorganelles and their function, Structure and use of compound microscope.

Histology: Maritimes (apical, intercalary, lateral) and their function; simple tissue (parenchyma, collenchymas, sclerenchyma); Complex tissue (xylem and phloem); Tissue systems (epidermal, ground, vascular); primary body and growth (root, stem, leaf); Secondary growth (root, stem), Animal tissues (Epithelial, connective, muscle and nervous tissues) and their functions in the body.

Unit III:

Transport: Plant water relationships, properties of water, diffusion, osmosis, imbibition, uptake of water by roots and theories of transport of water through xylem (ascent of water in xylem, cohesion-tension theory), apoplast and symplast theory; Transpiration-structure of leaf, opening and closing mechanisms of stomata, factors affecting transpiration and significance of transpiration.

Nutrition: Mineral Nutrition in plants, Heterotrophic nutrition in plants; Photosynthesis (Autotrophic-forms of nutrition), Chloroplast structure, two pigment systems, photosynthetic UNIT, light absorption by chlorophyll and transfer of energy, phosphorylation and electron transport system, Calvin-Benson Cycle (C_3), Hatch Slack Pathway (C_4), Crassulacan Acid Metabolism (CAM), factors affecting photosynthesis.

Unit IV:

Energy Utilization: (Respiration) - Structure of mitochondria, cellular respiration, relationship of carbohydrate metabolism to other compounds, Glycolysis, fermentation, formation of acetyl co-A, Kreb cycle, Electron Transport System and Oxidative Phosphorylation, ATP, factors affecting respiration; Elementary canal in humans, nervous and hormonal control of digestive systems, fate of absorbed food materials; Nutrition in humans, Reference values; General characteristics of blood vascular system, development of blood systems in animals, Composition of blood, circulation in blood vessels, formation of tissue fluids, the heart, functions of mammalian blood, the immune system.

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D. Teaching/ Learning/ Practice Pattern:

Teaching: 70%

Learning: 30%

Practice: 0%

E. Examination Pattern:

1. Theoretical Examination: Written

F. Reading List:

Books:

1. *J.N. Mitra, D. Mitra and S.K. Chowdhuri, "Studies in Botany" Volume I & II, Moulik Library Publisher, Kolkata,*
2. *M.J. Pelczar, E.C.S. Chan and N.R. Krieg, "Microbiology", Tata McGraw Hill Education, New Delhi, 1993.*
3. *B.P. Pandey, "Plant Anatomy", S. Chand & Company Ltd., New Delhi, 1997 revised edition.*
4. *H.S. Srivastava, "Plant Physiology", Rastogi Publishers, Meerut, 1998. 3rd edition*
5. *B.P. Pandey, "College Botany" Volume I & II, S. Chand Publisher, New Delhi, 2012 7th edition.*
6. *N.A. Campbell, J.B. Reece, "Biology" 8th edition, Person Education, Inc& Dorling Kinderley Publishing, Inc.*

Magazines:

1. *National Geographic Channel*
2. *Wikipedia, The Free Encyclopaedia.*

Journals:

1. *Journal of Biology, Bio Med Central Ltd, London, England.*
2. *Annals of Botany, Oxford Journals, USA.*
3. *Plant and Cell Physiology, Oxford Journals, USA.*

Name of the Module: Engineering Drawing
Module Code: CE 101
Semester: 1st
Credit Value: 2 [P=3, T=0, L=0]

A. Objectives:

The course is design to meet with the following objectives:

1. Increase ability to understand Engineering Drawing.
2. Learn to sketch and take field dimensions.
3. Learn to take data and transform it into graphic drawings.
4. Learn basic engineering drawing formats.
5. Prepare the student for future Engineering positions.

B. Learning Outcome:

Upon completion of the subject student's ability to**:**

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1. Understand orthographic projections and sections
2. Basic understanding of various standards
3. Develop engineering drawings
4. Utilise tools towards developments of drawings

C. Subject Matter:
Unit I:
    Indian Standards: Line symbols and line groups, sheet layout of rules of printing, preferred scales.
Unit II:
    Orthographic Projection: Theory of Orthographic Projection.
Unit III:
    First and third angle system of projection: Technical sketching, Multi-planar representation.
Unit IV:
    Glass box concept: Sketching of orthographic views and line.

D. List of Practical:
1. Technical writing of various types of letters.
2. Technical sketching of Scales- Plain, Diagonal, Vanier, Comparative and chord.
3. Technical sketching of Projection of points.
4. Technical sketching of Projection of lines.
5. Technical sketching of Projection of plains.
6. Technical sketching of Projection of solids.
7. Technical sketching of Orthographic Projection.

E. Teaching/ Learning/ Practice Pattern:
    Teaching: 70%
    Learning: 30%
    Practice: 0%

F. Examination Pattern:
    1. Practical Drawing.
    2. Assignment.

G. Reading List:
Books:

1. N. D. Bhatt, "Machine Drawing". 53th edition, Charotar Publishing House Pvt. Ltd.

2. V. Laxmi Narayanan & M. L. Mathur, "A Text Book of Machine Drawing", Jain Brothers, New Delhi. 13th edition

3. Jolhe "Machine Drawing", Charotar Publishing House Pvt. Ltd.

4. K. Venugopal and V. R. Prabhu "Engineering Graphics", New Age International Pvt. Ltd.1st edition

5. K. C. John, "Engineering Graphics", PHI Learning Pvt. Ltd.

6. D. M. Kulkarni, A. P. Rastogi, A. K. Sarkar, "Engineering Graphics with Auto CAD", PHI Learning Pvt. Ltd.

7. K. V. Natarajan, "Engineering Graphics", Dhanalakshmi Publisher.

8. French and Vierk "Fundamentals of Engineering Drawing", MGH.,3rd edition

Magazine:

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1. *Machine Design.*
2. *Design to Part Magazine.*

Journals:
1. *International Journal of Design Engineering.*

Name of the Module: Engineering Mechanics
Module Code: ME 101
Semester: 1st
Credit Value: 3 [P=0, L=3, T=0]

A. Objectives:
The course is designed to meet with the following objectives:
1. Ability to utilise scalar and vector analytical techniques for analysing forces in statically determinate structures.
2. Ability to apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems.
3. Student gets a basic idea of Centre of gravity, moment of inertia, mass moment of inertia, friction.

B. Learning Outcome:
Upon completion of the subject, students should be able to:
1. Basic understanding of different type of forces and moments
2. Solve force and moment balance equation by resolving forces.
3. Evaluation of centre of gravity, moment of inertia, mass moment of inertia,
4. Apply principles of kinematics and kinetics and effects of friction for solving problems

C. Subject Matter:
Unit I:
>   **Forces and Moments:** Force, Moment and Couple, Resultant of forces, Forces in space Equilibrium, FBD, General equations of equilibrium, Analysis of forces in perfect frames, Brief introduction to vector approach.

Unit II:
>   **Friction:** Introduction to dry friction, laws of friction, friction of simple machines, inclined planes, Screw jacks.

Unit III:
>   **Centre of gravity and moment of inertia:** Centre of gravity of axes, volume and composite bodies, Area moment of inertia and mass moment of inertia for plane figures and bodies.

Unit IV:
>   **Dynamics:** Kinematics and Kinetics, Rectilinear motion of particles, determination of position velocity and acceleration under uniform rectilinear motion (uniform and non-uniform accelerated rectilinear motion), Relative motion, construction of x-t, v-t and a-t graphs (simple problems), Projectile motion, Normal and Tangential components, Radial and Transverse components, simple problems, Equation of motion, D. Alembert's principle.

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D. List of Practical's: No Practical's

E. Teaching/ Learning/ Practice pattern:
>Teaching: 60%
>Learning: 40%
>Practice: 0%

F. Examination pattern:
>1. Theoretical Examination.

G. Reading lists:

Books:

1. *Mariam & Kraige, "Engineering Mechanics (Vol-II) Dynamics",5th edition Wiley.*
2. *Mariam & Kraige, "Engineering Mechanics, Vol-I (Statics)",5th edition, Wiley.*
3. *Timoshenko," Engineering Mechanics",4th editiion MGH.*
4. *Nelson, "Engineering Mechanics", 1st edition ,TMGH.*
5. *Shames and Rao, "Engineering Mechanics",4th edition, Pearson.*
6. *S. Chakraborty, "Engineering Mechanics", Everest Publishing House.*
7. *Beer and Johnson, "Vector Mechanics for Engineers",8th edition TMGH.*

Magazines:

1. *Popular Mechanics Everyday.*
2. *Engineering Magazine.*

Journals:

1. *International Journal of Applied Mechanics and Engineering.*
2. *Journal of Applied Mechanics, ASME.*
3. *Journal of Engineering Mechanics, ASCE.*

Name of the Module: Workshop Practice I
Module Code: ME 102
Semester: 1st
Credit Value: 2 [P=3, T=0, L=0]

A. Objectives:

The course is designed to meet the following objectives:

1. Acquire skills in basic engineering practice.
2. Identify the hand tools and instruments.
3. Acquire measuring skills.
4. Acquire practical skills in the trades.
5. Acquire practical skills in welding, carpentry, fitting.

B. Learning Outcome:

Upon completion of the subject, students should have the knowledge of:

1. Handling of tools and machine and understanding of workshop safety.

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2. Working principle of different tools.
3. Practical experimentation on different welding types.
4. Preparation of different carpentry joints.

C. Subject Matter:

Unit I:

Carpentry (Wood Working): Timber, Seasoning and Preservation, Plywood and Ply boards, Carpentry Tools, Engineering applications, Different Joints.

Unit II:

Metal Joining: Definitions of welding, brazing and soldering processes and their applications, Oxy acetylene gas welding process, equipment and techniques, types of flames and their applications, Manual metal arc welding technique and equipment, AC and DC welding, electrodes, constituents and functions of electrodes, welding positions, types of weld joint, common welding defects such as cracks, slag inclusion and porosity.

Unit III:

Bench work and Fitting: Tools for laying out, chisels, files, hammers, hand hacksaw, their specifications and uses.

Unit IV:

Laying out (bench work): Sawing and finishing by filing.

D. List of Practical:
1. T-Lap joints and Bridle joint (Carpentry Shop).
2. Gas Welding practice on mild steel flat/sheet up to 3 mm thick.
3. Lap joint by Gas Welding (up to 3mm thick).
4. Manual Metal Arc Welding practice (up to 5mm thick).
5. Pattern Making (Carpentry Shop).
6. Laying out (bench work), Sawing and finishing by filing.

E. Teaching/Learning/Practice Pattern:

Teaching: 20%

Learning: 20 %

Practice: 60%

F. Examination Pattern:
1. Job making.
2. Viva-voce.

G. Reading List:

Books:

1. *M. L. Begeman and B.H. Amstead, "Manufacturing Process" 8th edition, Wiley.*
1. *W. A. J. Chapman and E. Arnold, "Workshop Technology, Vol. 1, 2 & 3", CRC press Prentice Hall.5th edition*
2. *B. S. Raghuwanshi, "Workshop Technology, Vol. 1 & 2", Dhanpat Rai and Sons., 10th edition*
3. *Hazra and Choudhary, "Workshop Technology, Vol. 1, 2", Media Promoters.*
4. *V. Narula "Workshop Technology", S. K. Kataria & Sons.*

Magazines:
1. *International Metal Working News.*
2. *Industrial Distribution.*

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Journals:

1. *International Journal of Machine Tools and Manufacture.*
2. *Journal of Manufacturing Science and Engineering, ASME.*
3. *Journal of Manufacturing Technology and Research.*

Name of the Module: Basic Electrical & Electronics Engineering
Module Code: EE 101
Semester: 1ˢᵗ
Credit Value: 4 [P=2, T=0, L=3]

A. Objectives:

The course is designed to meet with the following objectives:

1. To make the students familiar with the course and its importance.
2. Introduction to Basic Electrical & Electronics Engineering.
3. Basic knowledge of DC circuits, Electromagnetism, AC fundamental.
4. Introduction to DC, AC single and three phase machine, their construction and working principles.
5. Introduction to measurement of electrical quantities.
6. Making familiar with P-N Junction.
7. Briefing to Semiconductor devices and their applications

B. Learning outcomes:

Students successfully completing this module will be able to:

1. Develop interest in learning the subject and be adequately trained to solve network problems.
2. Skilled both theoretically and practically to utilize conventional circuit solving procedures.
3. Substantially prepared to take up prospective design assignments.

C. Subject matter:

Unit I:

DC circuits: Definition of electric circuit, network, linear circuit, non-linear circuit, bilateral circuit, unilateral circuit, Dependent source, Kirchhoff's law, Principle of superposition. Source equivalence and conversion, Thevenin's theorem, Norton Theorem, nodal analysis, mesh analysis, star-delta conversion. Maximum power transfer theorem with proof.

Electromagnetism: Biot-savart law, Ampere's circuital law, field calculation using Biot-savart & ampere's circuital law. Magnetic circuits, Analogous quantities in magnetic and electric circuits, Faraday's law, self and mutual inductance. Energy stored in a magnetic field, B-H curve, Hysteretic and Eddy current losses, lifting power of Electromagnet.

Unit II:

Decision making: Simple if statement, if-else statement, nested if else statement, Switch statement, nested switch, the operator, goto statement.

Decision making & branching: while statement, do-while statement, for statement. Array

Unit III:

Transformers: Construction, Types, emf equation, voltage, current, impedence and turns ratio, auto-transformer, DC machines (motor and generator)–Construction, types, emf equation, equivalent circuit, starting, speed control, braking, applications. Single phase motors, types; need

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of rotating field, starting, running, speed control and applications.

Unit IV:

P-N Junction: Energy band diagram, Formation of P-N junction, built-in-potential forward and reverse biased P-N junction, formation of depletion zone, V-I characteristics, Zener breakdown, Avalanche breakdown and its reverse characteristics, junction capacitance and varactor diode. Simple diode circuits, load line, linear piecewise model; rectifiers: half wave, full wave, its PIV, DC voltage and current, ripple factor, efficiency, Clipper & Clamper Circuits.

Introduction to Transistors: Formation of PNP/ NPN junctions, energy band diagram; transistor mechanism and principle of transistors, CE, CB, CC configuration, transistor characteristics: cut-off active and saturation mode, early effect. Introduction to Field Effect Transistor: Structure and characteristics of JFET and MOSFET, depletion and enhancement type, CS, CG, CD configurations.

D. List of practicals: (Minimum eight experiments should be conducted by students)

1. To construct a series-parallel circuits and verify:

    Ohms law, Kirchhoff's laws

    Verify Thevenin's theorem.

    Verify Norton's theorem.

    Verify Maximum Power Transfer theorem.
2. Construct an R-L-C circuit and verify

    Voltage across R, L and C

    Verify the phasor sum of the voltages across the combination of R-L-C.
3. Measurement of power in the circuit made in 2 above and verify:

    The power consumed by Resistance, Inductance and Capacitance and the total power consumed by the circuit.
4. How does the power factor varies in the circuit of 2 above if Resistance, Inductance and Capacitance are varied.
5. Study of VI Characteristics of Silicon Diode.
6. Study of VI Characteristics of Zener Diode.
7. Design and Analysis of a Half wave Rectifier using Diode.
8. Design and Analysis of a center-tap Full wave Rectifier using Diodes
9. Design and Analysis of a Bridge Rectifier Circuit.
10. Design and Analysis of a Clipping Circuit with one voltage source. (Different possible configurations)
11. Design and Analysis of a Clipping Circuit with two voltage source. (Different possible configurations)
12. Design and Analysis of a Clamper Circuit.
13. Analysis of the characteristics of BJT (CE and CB mode)
14. Design and Analysis of fixed bias circuit using NPN transistor (DC)
15. Design and Analysis of emitter bias circuit using NPN transistor (DC)
16. Determination of the characteristics of JFET.
17. Determination of the characteristics of MOSFET.
18. Verification of truth tables of logic gates.

E. Teaching/ Learning/ Practice pattern:

Teaching: 40%

Learning: 10%

Practice: 50%

F. Examination pattern:

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1. Theoretical Examination: Written.
2. Practical Examination: Conduct Practical Examination and viva-voce.

G. Reading lists:
Books:
1. Theraja, "Electrical technology, Vol 1 &2", Nirja Construction & Development Co. (P) Ltd. 1st edition
2. Sen, P.C. "Principles of Electrical Machines and Power Electronics" John wileyand sons.2nd edition
3. V.K.Mehta, "Basic Electrical Engineering" S.Chand and Co. Publication.11th edition
4. Guru and Hiziroglu "Electric Machinery and Transformers", 3rd edition Saunders College Pub. NY, 1990
5. Malvino: "Electronic Principle" Tata McGraw-Hill Publishing Co.Ltd. 7th edition
6. Millman&Halkias: "Integrated Electronics" Tata McGraw-Hill Publishing Co.Ltd.2nd edition
7. Boylesteadand Nashelsky, Electronic Devices and Circuits Theory, 9/e, PHI, 2006. 9th edition
8. R.P.Jain,ModernDigitalElectronics,3/e,TMH,2000.3rd edition

Magazines:
1. IEEE Industrial Electronics
2. 2. Electrical Line, Canada.

Journals:
1. Electrical Engineering, Springer.

Name of the Module: Communication Skill
Module Code: HSS 101
Semester: 1st
Credit Value: 1 [P=2, T=0, L=0]

A. Objectives:
The course is design to meet with the following objectives:
1. To increase the Students ability to improve and utilize the skills necessary to be competent interpersonal communicator.
2. To Increase the student's understands of his or her own communication behaviour.
3. To Increase the students understands of others communication behaviours.
4. To improve the students communication skills of both social professional contexts.
5. To improve the students ability to demonstrate effective complete resolution skills.

B. Learning Outcomes:
Students successfully completing this module will be able to:
1. Develop their communication skills on the specific subject.
2. Learn communication skills and will be able to direct effectively in their world place.

C. Subject Matter:
Unit I:

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General Principles of Communication and Oral Communication: The Process of Communication, Principles of Communication (communication barriers, levels of Communication, Communication network, verbal, non-verbal) and Professional Communication. The Speech Mechanism, IPA symbols (vowel and consonant sounds), minimal pairs, word transcription, stress and intonation , active listening, types of listening, traits of a good listener, active versus passive listening,

Unit II:

Constituents of Effective Writing and Vocabulary: The sentence and its parts, articles, the verb phrase, tense and aspect, the active and passive, the adjective, interrogative and negative sentences, concord, preposition. Paragraph development, summary writing and reading comprehension, Word formation processes: affixation, compounding, converting, use of words in different parts of speech, idioms and phrases.

Unit III:

Business Correspondence and Communication Strategies: Characteristics of Business Letters, Drafting: Bio-data/Resume/Curriculum vitae (theory). Report Writing: Structure, Types of Reports (theory), Presentation Skills, public speaking and group discussion (theory) and Soft Skills (theory).

D. List of Practical:

1. Issue Writing
2. Writing Resumes and Applications
3. Writing Memos
4. Reading Comprehension
5. Vocabulary
6. Presentation Skills
7. Group Discussion
8. Extempore
9. Debates

E. Teaching/ Learning/ Practice Pattern:

Teaching: 40%
Learning: 10%
Practice: 50%

F. Examination Pattern:

1. Theoretical Examination

G. Reading List:

Books:

1. *Nira Konar, "English Language Laboratory", Prentice Hall India 2nd edition*
2. *Jones, Daniel, Cambridge English Pronouncing Dictionary with CD, New Delhi, 2009.18th edition*
3. *Roach, Peter, English Phonetics and Phonology with CD, CUP, India, 1983.4th edition*
4. *Cambridge Learners Dictionary with CD, CUP, New Delhi, 2009.4th edition*
5. *Rajeevan, Dutt, Sasikumar, A course in Listening and Speaking I & II with CD, CUP, New Delhi, 2007.*
6. *Rajeevan and Dutt, Basic Communication Skills, CUP, New Delhi, 2007.*
7. *Software: Orell Digital Language Lab Software.*
8. *R.C. Sharma and Krishna Mohan Business Correspondence and Report Writing 10.Meenakshi*
9. *Raman and Sangeeta Sharma Technical Communication, Oxford.2nd edition*
10. *Krishna Mohan and MeeraBannerji ,Development Communication Skills*

Magazines:

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1. *Communication Skill Magazine*
2. *Magazine for Communication*
3. *Communication Studies*

Journals:
1. *Developing Effective Communication Skills.*
2. *Cooperative Communication Skills.*
3. *Improving Communication Skills.*
4. *Key Communication Skills.*
5. *Journal on Communication.*

Name of the Module: Foreign Language (French) (Audit)
Module Code: HSS 103
Semester: 1ˢᵗ
Credit Value: 0[P=2, T=0, L=0]

A. objectives:
The course is design to meet with the following objectives:
1. The French Language course accords to a method created for Indian students who are complete beginners in French and who wish to acquire verbal communication skills in current scenario.

B. Learning outcome:
Students successfully completing this module will be able to:
1. Develop four skills in French i.e. Reading, Writing, Speaking, Comprehension.

C. Subject matter:
Unit I:
   Preliminaries of Grammar: Articles, Gender and Number of Nouns and Adjectives, Personal and Tonique Pronouns, Demonstrative and Possessive Adjectives, Preposition and Adverbs.
Unit II
   Conjunction: Pronominal Verbs Conjugation of Verbs of all the Groups in present Tense and Introduction to past and Future tense ,Interrogation, Negation and Imperatives.
Unit III
   Name of days, seasons, Months, colours, garments body parts and numbers, Computer, Commerce & Marketing related Vocabulary &Terminology, Phonetics and Pronunciation.

D. List of Practical:
   1. Issue Writing
   2. Writing Resumes and Applications
   3. Writing Memos
   4. Reading Comprehension
   5. Vocabulary
   6. Presentation Skills
   7. Group Discussion
   8. Extempore
   9. Debates

E. Teaching/ Learning/ Practice Pattern:
      Teaching: 40%

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Learning: 10%
Practice: 50%

F. Examination Pattern:
1. Theoretical Examination

G. Reading List:
 Books:
1. *Suggested book-Ailes Volume-I*
2. *G. Mauger: I (La Langue et de Civilisation francaise) Alliance française Paris Ile-de-France.*

Semester- II
(Common to all Branches)

Name of the Module: Engineering Mathematics II
Module Code: MAS 201
Semester: 2ⁿᵈ
Credit Value: 4 [P=0, T=1, L=3]

A. Objectives:
The course is design to meet with the following objectives:
1. Imparting theoretical knowledge to the students about three and more dimensional objects in space and to improve their capability of visualising of objects in space.
2. Making student competent enough to construct a differential equation/ mathematical modelling for every real life situation with its solution.
3. Giving students theoretical knowledge of vectors with the flavour of Calculus.
4. Introduce the concepts of Laplace and Fourier transforms and its application to the solution of differential equations (ODE & PDE) to the students.

B. Learning Outcomes:
Upon completion of the subject, students will:
1. Have strong visualising capability in their mind about any object.
2. Be so trained that they will recognize various real life situation/ problem and able to solve them by constructing a differential equation/ mathematical model.
3. Be able to find the Laplace and Fourier representation as well as transforms of functions of one variable.

C. Subject Matter:
Unit I:
  Coordinate Geometry Of Three Dimensions: Equation of a sphere, plane section of a sphere, tangent plane, orthogonality of spheres, definition and equation of right circular cone and right

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circular cylinder.

Unit II:

Vector Calculus: Differentiation and integration of vector functions, scalar and vector fields, Gradient, Directional derivative, Divergence, Curl, Line integral, Surface integral and Volume integral, Green's, Gauss' and Stokes' theorems (without proofs) and their simple applications.

Unit III:

Ordinary Differential Equations: Formulation of Differential equations, Linear Differential Equations and reducible to linear form, Exact Equations, Reducible to exact form, Linear differential equations with constant coefficients, Second order ordinary differential equations with variable coefficients, Homogeneous form, Change of dependent variable, Change of independent variable, Normal form, Variation of Parameters, Solution in series of second order LDE with variable co-efficient (C.F. only), Bessel's and Legendre differential equations with their series solutions, Orthogonal properties, recurrence relations and generating function of Bessel functions and Legendre polynomials.

Partial Differential Equation: Linear and non-linear Partial Differential Equation of order one, Linear Partial Differential Equation with constant coefficient, Partial Differential Equation of order two with variable coefficients.

Unit IV:

Basic Transform: Laplace & Fourier.

D: Teaching/ Learning/ Practice Pattern:

Teaching: 70%
Learning: 30%
Practice: 0%

E: Examination Pattern:

1. Theoretical Examination and open book examination.

F: Reading Lists:
Books:
1. Shanti Narayan, "Analytic Solid Geometry", S. Chand 7th edition.
2. M. D. Raisinghania, "Vector Analysis", S. Chand, 5th edition
3. R. K. Jain& S R. K Iyengar, "Advanced Engineering Mathematics", Narosa. 4th edition
4. M. D. Raisinghania, "Ordinary & Partial Differential equations", S. Chand. 17th edition
5. M. D. Raisinghania, "Advanced Differential equations", S. Chand. 5th edition
6. H. K. Dass, "Higher Engineering Mathematics", S. Chand & Co, 1st edition.
7. B. S. Grewal , "Engineering Mathematics", S. Chand & Co. 43rd edition
8. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th edition, Wiley Eastern .
9. S. L. Ross, "Differential equations", Willey.3rd edition
10. Pal & Das , "Engineering Mathematics", Vol. I, U. N. Dhar.1st edition
11. J. N. Sharma, A. R. Vasishtha, "Vector Calculus", Krinhna Prakashan Mandir, Meerut. 1st edition
12. P. P. Gupta, G. S. Malik, "Vector Calculus", KedarnathRamnath, Meerut. 1st editionv
13. Brahma Nand, B. S. Tyagi, B. D. Sharma, "Co-ordinate Solid Geometry", Kedarnath Ramnath, Meerut, Delhi. 1st edition
14. A. R. Vasishtha, D. C. Agarwal, "Analytical Geometry of Three Dimensions", Krinhna Prakashan Media (P) Ltd, Meerut. 6th edition

Magazines:

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1. *Current Science (Indian Academy of Science).*
2. *The Mathematics Student (Math Student) (Indian Mathematical Society).*
3. *Mathematical Spectrum(The University of Sheffield).*
4. *Mathematics Magazine (Mathematical Association of America).*
5. *Plus magazine (University of Cambridge).*
6. *Ganithavahini (Ramanujan Mathematical Society).*
7. *Mathematics Today, London Metropolitan University.*

Journals:
1. *Journal of Engineering Mathematics, Springer.*
2. *Journal of Computational and Applied Mathematics, London Metropolitan University.*
3. *The Journal of Indian academy of Sciences.*
4. *Bulletin of Pure and Applied Sciences.*

Name of the Module: Basic Elements of Mechanical Engineering
Module Code: ME 201
Semester: 2nd
Credit Value: 3 [P=0, T=0, L=3]

A. Objectives:
The course is design to meet with the following objectives:
1. Ability to utilise scalar and vector analytical techniques for analysing forces in statically determinate structures.
2. Ability to apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems.
3. Student gets a basic idea of Engineering Mechanics, Fluid Mechanics, Strength of Material and Thermodynamics.

B. Learning Outcome:
Upon completion of the subject, students will be able to:
1. Understand basic laws related to thermodynamics, fluid mechanics and strength of materials.
2. Identify different thermodynamic processes, cycles.
3. Solve problems related to thermodynamics, fluid mechanics and strength of materials
4. Analyse 1st law of thermodynamics for closed and open systems.

C. Subject Matter:
Unit I:

 Thermodynamics: Introduction, Concepts of systems and control volumes, properties of a system, state and equilibrium, processes and cycles, quasi-static process, reversible & irreversible process, cycle. Temperature and Zeroth Law of Thermodynamics, Heat and Work transfer Definition, Sign convention, various P-dV work done (Isobaric, Isochoric, Polytrophic, adiabatic and isothermal processes) and related problems.

Unit II:

 1st Laws of Thermodynamics for closed & open systems (ii) Non Flow Energy Equation (iii) Steady State, Steady Flow Energy Equation and related problems. Equivalence of two statements, Definition of Heat Engines, Heat pumps, Refrigerators Carnot and related problems. Air Standard cycles – Otto and Diesel cycle and their efficiencies and related Problems.

Unit III:

 Fluid Mechanics: Properties of fluid - Mass and weight density, specific gravity, specific volume,

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viscosity and Newton's law of viscosity, Compressibility, Types of fluid, surface tension and capillarity. Fluid pressure at a point and Pascal's law, absolute, gauge and vacuum pressures, pressure variation in a fluid at rest, pressure measurement, Manometers and Mechanical Gauges. Continuity equation, Bernoulli's equation and its application

Unit IV:

Strength of Materials: Concept of simple stresses and strains. Yield strength, Normal stress Shear stress, Bearing stress, Normal strain, Shearing strain, Hooke's law, Poisson's ratio, Examples.

D. List of Practical: No practicals**.**

E. Teaching/Learning/Practice Pattern:

Teaching: 60 %

Learning: 40 %

Practice: 0%

F. Examination Pattern:

1. Theoretical Examination.

G. Reading List:

Books:

1. *P. K. Nag , "Engineering Thermodynamics" 5th Edition, Tata McGraw Hill Publisher*

2. *S. K. Som & G. Biswas, "Introduction to Fluid Mechanics & Fluid Mechines"3rd edition, Tata McGraw Hill*

3 *Timoshanko & Young, "Elements of Strength of Materials" 5th edition ,D Van Nostrand Company*

4. *Mariam & Kraige, "Engineering Mechanics (Vol-II) Dynamics"6th edition , Wiley Publisher*

5 *Meriam & Kraige, "Engineering Mechanics, Vol-I (Statics)" 6th edition ,Wiley India*

Magazine:

1. *PopularMechanics Everyday*

2. *Engineering Magazine*

Journals:

1. *International Journal of Applied Mechanics and Engineering*

2. *Journal of Applied Mechanics, ASME*

3. *Journal of Engineering Mechanics, ASCE.*

Name of the Module: Programming in C
Module Code: CSE 201
Semester: 2nd
Credit Value: 4 [P=8, T=0, L=0]

A. Objectives:

The course is designed to meet with the following objectives:

1. Introducing art, science and engineering of C programming language to the students of all UG programs.
2. Teaching and training of different problems in data structures.
3. Guiding and training students to write efficient coding.
4. Guiding& training students to fragment problems into different functions or units.

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B. Learning outcomes:

Students successfully completing this module will be able to:

1. Understand the basic terminology used in computer programming.
2. Write, compile and debug programs in C language in different operating systems.
3. Design programs involving decision structures, loops and functions.
4. Use and apply the dynamics of memory by the use of pointers in engineering applications.
5. Use and apply the differences between structure oriented and function oriented programming in programming applications.

C. Subject matter:

Unit I:

Basic concept: Some basic concept of binary number, Octal number, hexadecimal number system and there conversion among them, Assembly language, high level language, Compiler and assembler (basic concept).

Keyword & Identifiers: History & Importance of C, Basic structure of C programs, C fundamentals: The C character set identifier, Constants and keywords, data types & size, variable names, declaration, statement , C token, symbolic constant.

Operators and Expression: Arithmetic Operators, Relational Operators, Logical Operators, Assignment Operators, Increment & Decrement operators, Condition Operators, Bitwise Operators, Special operators, precedence of arithmetic operators.

Managing Input & output operations: using of printf ( ) & scanf ( ).

Unit II:

Decision making: Simple if statement, if-else statement, nested if else statement, Switch statement, nested switch, the operator, goto statement.

Decision making & branching: while statement, do-while statement, for statement. Array

Unit III:

String & pointer: One-dimension array, Two-dimension array and multi dimension array. String: Operation on String without using library function and using library function. Pointer: Declaration of pointer variables, accessing the variable by using pointer, pointer increment and decrement operator, pointer and array.

Functions: Basic functions, function type, function with no argument & no return value, function with no argument but return value, function with argument & return value, Storage class identifier, Call by reference, Recursive function, Pointer to function.

Unit IV:

Structure & Union: Defining a structure, accessing of structure variable, structure and array, array within structure, Nested structure, structure & functions, Pointer & structure, Unions.

File management system: Advantage of using files, Open, close, read, write in the files, Operation on files.

Dynamic memory Allocation: use of Malloc, calloc, realloc, free. Library functions, Linked list concept.

The pre-processor: macro statements.

D. List of practicals: (Minimum eight experiments should be conducted by students)

1. Write a program to find the highest number of a given set of numbers and print the numbers of the set in descending order. [Minimum size of set=50]
2. Write a program to list even numbers and odd numbers separately in ascending order of a given set of minimum size of 50.
3. Write a program to find roots of a given quadratic equation.
4. Write a program to test whether a given number is prime or not.
5. Write a program to check whether a given number is a palindrome or not (ForEg. 121-→121).

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6. Write a program to compute the following series and test it for different inputs.

   a) $2 + 4 + 6 + 8 \dots \dots \dots \dots \dots \dots \dots \dots$
   b) $f(x) = 1! + 2! + 3! + 4! + \dots \dots \dots$
   c) $f(x) = 1 + x + \dfrac{x^2}{2!} + \dfrac{x^3}{3!} + \dots \dots \dots$
   d) $f(x) = 1 + x + x^2 + x^3 + x^4 + \dots \dots \dots$

7. Write a program to display the following patterns using nested for loops.

```
a)  *              b)  # # # #      c)  1 0 1 0     d)      *          e)  A B C D C B A     f) |*       *
    * *                # # #            0 1 0          * *              A B C   C B A        **     **
    * * *              # #              1 0          * * *             A B       B A        ***   ***
    * * * *            #                0          * * * *            A           A         ********
```

8. Write a C program to find the maximum element from given input array elements.
9. Write a C program to sort an array elements using BUBBLE sort.
10. Implement the C program for the following numbering system conversion:
    1. Decimal to Binary and Vice-versa (By a single algorithm both for integer and fractional part).
    2. Octal to Binary and Vice-versa.
    3. Hexadecimal to Binary and Vice-versa.
11. Write a program to add two given matrices each of size (nXm).
12. Write a program to multiply any two given matrices.
13. Write a program to check whether a given matrix is Identity matrix or not.
14. Write a program to generate calendar of a given year & print both in desk and wall mode.
15. Write a program to implement factorial of a given input using recursive function.
16. Write a program to differentiate between call by value and call by reference.
17. Write a program to pass an array to a function and find minimum value of it.
18. Write a program to explain scope, visibility and the lifetime of variables.
19. Write a program to explain reference variable and its implementation.
20. Write a program to swap two values using pointer and function.
21. Write a mini project to store all records of students and search by their name, roll number or registration number.
22. Write a program the explain the concept of pointer to a structure..
23. Write a program to differentiate between Enumerated data types, Union and Structures.
24. Write a program to create, edit, open, delete a file and perform different operations accordingly.
25. Write a program to backup one file to another file.
26. Write a program to merge two files.
27. Write a mini project to control mouse cursor and display whether left, right or scroll happens.

E. Teaching/ Learning/ Practice pattern:

       Teaching: 40%
       Learning: 10%
       Practice: 50%

F. Examination pattern:

    1. Theoretical Examination: Open book and on line.
    2. Practical Examination: Conduct Programming test and viva voice.

G. Reading lists:
Books:

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1. Kerninghan and Ritchie , "The 'C' programming language",3rd edition , Prentice Hall.
2. Yashavant P. Kanetkar, "Let Us C",13th editon , Infinity Science Press, 2008.
3. Herbert Schildt, "C: The Complete Reference",4th edition , McGraw-Hill Education, 2000.
4. Balaguruswamy, "Programming InAnsi C, 6th edition", Tata McGraw-Hill Education, 2011.
5. Govil, Agrawal, Mathur& Pathak, "Computer Fundamentals and Programming in C", 15th edition Jaipur Publication House(JPH)
6. M.T. Somashekara, "Programming in C", 1st edition, PHI Learning Pvt. Ltd., 2005.
7. Sinha&Sinha, "Foundations of Computing", 3rd edition, BPB Publications, 2002.
8. J. B. Dixit, "Computer Fundamentals and Programming in C",1st edition, Firewall Media, 2009.
9. Stephen G. Kochan, "Programming in C",4th edition , Addison-Wesley Professional, 2014.
10. K. N. King, "C Programming: A Modern Approach",2nd edition , W.W. Norton, 2010.
11. Zed Shaw, "Learn C The Hard Way", Addison Wesley Professional, 2015.
12. Steve Oualline, "Practical C Programming, 3rd Edition", O'Reilly Media, Inc., 2003.
13. Ajay Mittal, "Programming In C: A Practical Approach", 3rd edition, Pearson Education India, 2010.
14. A.P.Godse, D.A.Godse, "Computer Concepts and Programming in C", 1st edition, Technical Publications, 2008.

Magazines:

1. C/C++ Users, CMP Media LLC publication, United States.
2. EPS Software Corp/CODE Magazine, 6605 Cypresswood Drive, Suite 300 Spring, TX 77379.

Journals:

1. Science of Computer Programming: Methods of Software Design: Techniques and Applications, Elsevier, ISSN:0167-6423
2. Programming and Computer Software, Springer, ISSN: 0361-7688.
3. Dr. Dobb's Journal, United Business Media publication, United State, ISSN: 1044-789X
4. Journal of C Language, CMP Media LLC publication, United States
5. C vu Journal, ACCU, UK.

Name of the Module: Environmental Science
Module Code: CHY 201
Semester: 2nd
Credit Value: 3 [P=0, T=0, L=3]

A. Objectives:

The course is designed to meet with the following objectives:

1. Imparting the knowledge to the students in the area of Environmental Engineering.
2. Providing teaching and learning to make students acquainting with advanced science and technology in Environmental Science.
3. Injecting the future scope and the research direction in the discipline of Environmental Engineering.
4. Making students competent to the research and development in Environmental Engineering.

B. Learning outcomes:

Students successfully completing this module will be able to:

1. Adequately train them to become Scientist, trainers and Chemical Engineers.

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2. Be skilled both to control and maintenance in Environmental pollution, waste water treatment and other related activities in Environmental Engineering.
3. Substantially prepared to take up prospective research assignments.

C. Subjects Matters:

Unit I:

Environment: Concepts of Environment, Environmental gradients, Tolerance levels of environment factor, EU, US and Indian Environmental Law. Chemistry in Environmental Engineering: Chemistry of the atmosphere, combustion related air pollution, global environmental problems - ozone depletion, greenhouse effect, acid rain etc.

Ecological Concepts: Biotic and Abiotic components, Ecosystem Process: Energy transfer, Food Chain and Food Web, Water cycle, Oxygen cycle, Carbon cycle, Nitrogen cycle etc., Soil chemistry, Soil composition, properties, identification and classification, Noise pollution Effect of noise on people, rating systems, community noise sources and criteria, traffic noise predicti on, noise control, Noise standards, measurement and control.

Unit II:

Waste Water Treatment: Water Treatment: water quality standards and parameters, Ground water. Water treatment processes, Pre-treatment of water, Conventional process, advanced water treatment process. DO and BOD of Waste water treatment process, primary and secondary treatment of waste water, Activated sludge treatment: Anaerobic digestion, Reactor configurations and methane production. Water resources, characteristics of water, water pollutants, oxygen demanding wastes, sur face water quality, groundwater quality, water treatment systems, biomedical wastes treatment techn ologies and disposal options.

Unit III:

Solid waste, Definition and characteristics of industrial and hazardous wastes, Hazardous waste management, Solid Waste Management, Source classification and composition of MSW: Separation, storage and transportation, Reuse and recycling, Waste Minimization Techniques, Hazardous waste and their generation, Transportation and treatment: Incinerators, Inorganic waste treatment. E.I.A., Environmentalauditing,Hazardous substances and risk analysis: Hazardous substance legislation, risk assessment, hazard deification, potential carcinogens, toxicity testing in animals, human exposure assessment.

Unit IV:

Air quality standards, emission standards,emission standards, criteria pollutants, air pollution and me teorology, atmospheric dispersion, emission controls, Air pollution and pollutants, criteria pollutants, Acid deposition, Global climate change –greenhouse gases, non-criteria pollutants, air pollution meteorology, Atmospheric dispersion, Industrial Air Emission Control, Flue gas desulphurization, NOx removal, Fugitive emissions.

D. Reading List:

Books:

1. G. Kiely,"Environmental Engineering" Irwin/ McGraw Hill International Edition, 1997, ,3rd edition
2. Arcadio P. Sincero&Gergoria A. Sincero, "Environmental Engineering" Prentice Hall India 5th edition
3. M. L. Davis and S. J. Masen, "Principles of Environmental Engineering and Science", McGraw Hill International Edition, 2004, 3rd edition
4. Curringham&Saigo, "Environmental Science", TMH,1st edition
5. Gilbert M. Masters & Wendell P. Ela, "An Introduction to Environmental Engineering and Science", PHI Publication.7th edition

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6. *Gilbert M Masters,   "Introduction to Environmental Engineering and Science" Prentice   Hall,   3rd edition*
7. *J. G. Henry and G. W Heinke, "Environmental Science and Engineering" Benjamin/Cummings Publishers, 2nd edition*
8. *M.L. Davis and D.A. cornwell, "Introduction to Environmental Engineering" McGraw-Hill Education*
3rd edition

Magazines:
   1. *Applied Environmental Research Foundation*
   2. *Environmental Science and Engineering*
   3. *Climate Wire*
   4. *Down to Earth*
   5. *The Green Economist*
   6. *Green Wire*

Journals:
1. *Journal of Environmental Science, Elsevier Publication*
2. *Environmental Science and Technology, ACS Publication*
3. *Energy and Environmental Science, RSC Publication*
4. *Environmental International, Elsevier Publication*

Name of the Module: Engineering Physics II
Module Code: PHY 201
Semester: 2nd
Credit Value: 4 [P=2, T=0, L=3]

A. Objectives:
The course is design to meet with the following objectives:
   1. Imparting theoretical & practical knowledge to the students in the area of Engineering Physics.
   2. Providing teaching and learning to make students acquainting with modern state-of-art of Engineering.
   3. Injecting the future scope and the research direction in the field of Physics with specific specialization.
   4. Making students competent to design & development of Engineering Physics.

B. Learning Outcomes:
Students successfully completing this module will be able to:
   1. Adequately trained to become Engineers.
   2. Substantially prepared to take up prospective research assignments. Students will be substantially prepared to take up prospective research assignments.

C. Subject Matter:
Unit I:

   Electricity: Coulombs law in vector form, Electrostatic field and its curl, Gauss's law in integral form and conversion to differential form, Electrostatic potential and field, Poisson's Eqn., Laplace's

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Department of Mechanical Engineering

Eqn. (Application to Cartesian, Spherically and Cylindrically symmetric systems-effective 1D problems) Electric current, drift velocity, current density, continuity equation, steady state current Dielectrics concept of polarization.

Unit II:

Magnetostatics & time varying Field: Lorentz force, force on a small current element placed in a magnetic field, Biot-Savart law and its applications, divergence of a magnetic field, vector potential, ampere's law in integral form and conversion to differential form, Faraday's law of electromagnetic induction in integral form and conversion to differential form.

Electromagnetic theory: conception of displacement current, Maxwell 's field equations, Maxwell's wave equation and its solution for fee space, E.M wave in a charge free conducting media, skin depth, physical significance of skin depth, E.M. energy flow & pointing vector.

Unit III:

Quantum Mechanics: Wave particle duality, Compton effect, Photo electric effect, Black body radiation, Heisenberg's uncertainty relation, concept of wave packet**.** Conception of probability and probability density, operators, commutator, Formulation of quantum mechanics and basic postulates, Time dependent Schrodinger's equation, Formulation of Time independent Schrodinger's equation, physical interpretation of wave function, Free particle and particle in a box.

Unit IV:

Statistical Mechanics: Concept of energy levels and energy states, Microstates, macrostates and thermodynamic probability, equilibrium macrostate, MB, FD, BE statistics (No deduction necessary), fermions, bosons (definitions in terms of spin, examples), physical significance and application, classical limits of quantum statistics Fermi distribution at zero & non-zero temperature, Bose-Einstein statistics – Planck's law of blackbody radiation.

D. List of practicals: (Minimum six experiments are required to be performed)
 1. Determination of dielectric constant of a given dielectric material.
 2. Determination of resistance of ballistic galvanometer by half deflection method and study of variation
 of   logarithmic decrement with series resistance.
 3. Determination of specific charge (e/m) of electron by J.J. Thomson's method.
 4. Determination of Planck's constant using photocell.
 5. Determination of Rydberg constant by studying Hydrogen/ Helium spectrum.
 6. Determination of Stefan's radiation constant.
 7. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment.
 8. Determination of Hall co-efficient of semiconductors.
 9. Determination of band gap of semiconductors
 10. Use of carry Foster's bridge to determine unknown resistance

E. Teaching/ Learning/ Practice Pattern:
Teaching: 40%
Learning: 10%
Practice: 50%

F .Examination Pattern:
1. Theoretical Examination: Open book and on line.
2. Practical Examination: Conducting Experiment and Viva-Voce.

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Department of Mechanical Engineering

G. Reading lists:

Books:

1. Herbert Goldstein, Charles P. Poole and John Safko, "Classical Mechanics" 3rd edition, Pearson.

2. N. C. Rana and P. S. Joag, "Classical Mechanics", Tata McGraw Hill Education Private Limited, New Delhi.

3. D. Chattopadhyay and P. C. Rakshit, "Electricity and Magnetism", New Central Book Agency (P) Ltd. 3rd edition

4. David J. Griffiths, "Introduction to Electrodynamics," 3rd edition, PHI Learning Private Limited.

5. W. H Hayt and J A Buck, "Engineering Electromagnetics" 7th edition, Tata McGraw Hill Education Private Limited, New Delhi.

6. Eisenberg and Resnick, "Quantum Physics", 2nd edition, Wiley India.

7. F. Reif, "Statistical Physics" Tata McGraw Hill Education Private Limited, New Delhi.

8. S. N. Ghoshal, "Atomic Physics" S. Chand 1st edition

9. Beiser, Mahajan and Choudhury, " Concepts of Modern Physics" Tata McGraw Hill Education Private Limited, New Delhi., 6th edition

10. A. B. Gupta, "Modern Atomic and Nuclear Physics" BOOKS and Allied (P) Ltd. ,1st edition 2nd edition

11. Jeremy Bernstein, Paul M. Fishbane and Stephen G. Gasiorowicz "Modern Physics" Pearson. 2nd edition

12. Richard P. Feynman, Robert B. Leighton and Matthew Sands, " The FEYNMAN Lectures on Physics" Vol. I to Vol. IV, Pearson 8th edition

13. D. Chattopadhyay and P. C. Rakshit, "An Advanced Course in Practical Physics" New Central Book Agency (P) Ltd. 10th edition

Magazine:

1. Resonance
2. American Teacher
3. Scientific Physics
4. Physics Today
5. Physics For You

Journals:

1. Nature
2. Physical Review Letter
3. Physical Review A & B
4. Applied Physics Letters (APL)
5. Proceedings of the National Academy of Sciences
6. Chemical Physics Letters
7. Journal of Physics: (Including A, B, C, D, E, F & G)
8. Journal of Scientific & Industrial Research
9. Indian Journal of Engineering & Material Sciences
10. Indian Journal of Radio and Space Physics

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Department of Mechanical Engineering

Name of the Module: Digital Electronics & Logic Design
Module Code: ECE 201
Semester: 2ⁿᵈ
Credit Value: 4 [P=2, T=0, L=3]

A. Objectives:

The course is designed to meet with the following objectives:
1. To make the students to build a solid foundation about Boolean algebra.
2. To make the students to study Digital Logic Gates and Circuits.
3. To provide a clear foundation of Modern Digital System.

B. Learning outcomes:

At the end of this module, students are expected to be able to
1. Clear understanding & utilization of logic gates
2. Design and develop of advanced TTL logic circuits
3. Utilization of Combinational and Sequential circuits, Counters, ADC and DAC

C. Subject matter:

Unit I:

> **Number Systems:** Decimal, Binary, Octal and Hexadecimal systems, conversion of a number from one base to another.
> **Codes:** BCD, Excess- 3, Gray, Reflected, ASCII, EBCDIC.
> **Algebra for logic circuits:** Logic variables; Logic constants; Logic functions- NOT, AND, OR, NAND, NOR, Ex-OR;
> **Combinational circuits:** Full Adder / Subtractor, BCD Adder, LAC Adder, Comparator, Decoder, Encoder, Priority Encoder, MUX/DEMUX & there structures, Combinational logic design using ROM array, Applications of MSI designs.

Unit II:

> **Minimization Techniques & System Design:** Basic models of sequential M/C, Analysis of Asynchronous and Synchronous circuits, Synthesis of completely and incompletely specified synchronous sequential M/Cs, Combination & Sequential Circuits. Boolean Algebra (including Shanon's expansion theorem and consensus theorem); Ven diagram representation, Canonical representations-min-term, max-term; Karnaugh map simplification, Quine Mc-clusky minimization, Minimization of Multiple Input and multiple Output system, Introduction to state machines, Classification of State Machines, State Machine Applications, Analysis of State Machine, State table, State Diagram, State Equation, State reduction and State assignment.

Unit III:

> **Other Gates & Circuits:** Difference between combinational and sequential circuits,
> **Sequential Gates**: Triggering of sequential logic circuits. Difference between flip flop and latch Construction of RS, D, JK, JK master slave, T flip flops using basic gates, preset and clear signal,
> **Shift Registers**: Serial in serial out – Serial in parallel out, Parallel in serial out, Parallel in parallel out, Universal Shift Registers & their Applications.
> **Counters:** Asynchronous and synchronous counter, Ripple counter, Mod-N counter, Up-down counter, Ring counter, Johnson counter, Programmable counter – Applications, Design of Synchronous State Machine (including Counter) and Asynchronous state machine.

Unit IV:

> **Logic Families:** Comparative studies of different type of logic families like RTL, Diode logic, DTL, TTL, IIL, HTL, ECL, MOS & CMOS etc. with the following characteristics: (a) logic levels, (b) power dissipation, (c) fan in and fan out, (d) propagation delay, and, (e) noise immunity.

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Data Converters: Digital to Analog Converters: Binary weighted resistor type, R-2R ladder type, Specifications and applications of DA converter. Analog to Digital Converter: Comparator type, Successive approximation type, Dual slope AD converter, Specifications and applications of AD converter.

D. List of Experiments: (Minimum eight experiments should be conducted by students)

1. Study Data Hand Book and list at least 5 chips for each of primary, secondary gates & flip-flops and draw their diagram with pin configuration.
2. Verify Truth Table of NOT, 2-input AND and 2-input OR gate thereby inference.
    i)   Single line definition of multiple input AND & OR gate.
    ii) What is the primary difference between NOT gate from AND & OR gate.
3. Study the Truth Table of the following by circuits.

    i)

    ii)
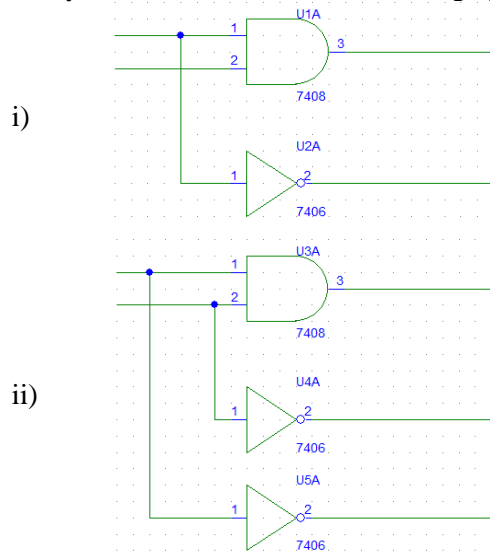
    iii)   Compare the Truth Table of i) & ii) and that of AND gate and state inference.
4. Design Gray to Binary and Binary to Gray Converter & test
5. Design and test byte operated even parity generator & then convert it to odd parity generator.
6. Design and test (7,4) Hamming Code Generator and Error Correction decoder.
7. Design a Majority Gate and use it & a XOR gate to realize Adder Circuit & Verify.
8. With Serial Data input design a single circuit for test of >,<and =for two data.
9. Minimize the following logic system with SOP by tabular technique & implement the circuit.
    i) $f_1(A,B,C,D) = m_0 + m_1 + m_2 + m_3 + m_5 + m_6 + m_{10} + m_{13} + m_{15}$
    ii) $f_2(A,B,C,D) = m_0 + m_1 + m_2 + m_3 + m_5 + m_7 + m_{10} + m_{13}$
    iii) $f_3(A,B,C,D) = m_1 + m_2 + m_4 + m_5 + m_6 + m_7$
10. Minimize the following logic circuit defined in POS by tabular minimization technique:
    i) $f_1(X,Y,Z) = M_0.M_1.M_3.M_7$
    ii) $f_2(X,Y,Z) = M_0.M_1.M_2.M_6.M_7$
11. Write a C programmed to implement Tabular Technique for minimization of system as in problem (8)& (9)
12. Test Truth Table of
    i)   S – R flip flop
    ii) J – K flip flop
    iii) D – flip flop
    iv) T – flip flop
13. Design 1 bit Read/Write memory with flip-flop and other logic gate & test.

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14. Design Serial input & parallel output Shift register & test.
15. Design a binary counter & test.
16. Design one ADC &one DAC circuit & test.

E. Teaching/Learning/Practice Pattern:

Teaching: 40%

Learning: 10%

Practice: 50%

F. Examination Pattern:

1. Theoretical Examination: Open book/ Regular examination and on line test.
2. Practical Examination: Conducting Experiment and Viva-Voice.

G. Reading List:

Books:

1. *J Crowe & B. Hayes-Gill, "Introduction to Digital Electronics", Newnes. 3rd edition*
2. *T. L. Floyd, "Digital Fundamentals"(11th Edition), Prentice Hall.*
3. *Taylor L. Both, "Introduction to Computer Engineering", 3rd Ed., John Wiley & Sons*
4. *R. P. Jain, "Modern Digital Electronics", Tata McGraw Hill .4th edition*
5. *R L Morris & J R Miller, "Designing with TTL integrated circuits", McGraw Hill, 1st edition*
6. *C. H. Roth (Jr.), "Fundamentals of Logic design", Cengage Engineering. 3rd edition*
7. *M. Morris Mano, "Digital Logic Design"(3rd Edition), Prentice Hall.*
8. *Malvino& Leach, "Digital Principles and Applications", Tata McGraw Hill.7th edition*
9. *Anand Kumar, "Fundamentals of Digital Circuits", Prentice Hall.2nd edition*

Magazines:

1. *Planet Analog,http://www.planetanalog.com/*
2. *IEEE Spectrum,http://spectrum.ieee.org/*
3. *Electronics for you, EFY Enterprises Pvt. Ltd, New Delhi.,http://www.electronicsforu.com/*
4. *Electropages,http://www.electropages.com/*

Journals:

1. *International Journal of Electronics Devices and Circuits.*
2. *IEEE Transaction on Computer-Aided Design of Integrated Circuits and System.*
3. *IEEE Transaction on Computer.*

Name of the Module: Historiography of Science & Technology
Module Code: HSS 201
Semester: 2nd
Credit Value: 3[P=0, T=0, L=3]

A. Objectives:

The course is design to meet with the following objectives:

1. Providing teaching with inclusive learning.
2. Imparting theoretical lectures with case discussion.
3. Making students aware about the importance of this subject in their future career.

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B. Learning Outcomes:

Students successfully completing this module will be able to:

1. Work with efficiency as they had knowledge of the subject.
2. Perform much better in their workplace.

C. Subject Matter:

Unit I:

      Introduction: An overview: definitions, Different approaches to the scientific explorations, to introduce humanity's endeavour behind science and its application over the centuries, characteristics of histography of science and technology.

Unit II:

      Motivation: Nature of drives, needs and motives, work motives, need of hierarchy theory and two factor theory of motivation, How to motivate the workers at work, factors effecting the morale of workers.

      Lives of Eminent Scientists: To understand the Background, Opportunities, Achievements and Qualities in their efforts to become Scientist of first order.

      Scientific Eras: Course of Civilization and Scientific Endeavour.

      Contribution of science: Contribution to the present day World.

Unit III:

      Answers to the Criticism that Science has created a World full of Pollutions.

D. Teaching/Learning/Practice Pattern:

      Teaching: 40%

      Learning: 10%

      Practice: 50%

E. Examination Pattern:

      1. Theoretical Examination: Open book/ Regular examination and on line test.

F. Reading List:

Books:

1. *Agassi, Joseph. Towards an Historiography of Science, Wesleyan University Press. 1963. 1ˢᵗ edition*
2. *Kragh, Helge An Introduction to the Historiography of Science, Cambridge University Press. 1990.*
3. *Kuhn, Thomas. The Structure of Scientific Revolutions, Chicago: University of Chicago, 1962 (third edn, 1996)*
4. *Gopalakrishnan, K.V. Inventors Who Revolutionised Our Lives, National Book Trust, India. 1999. 1ˢᵗ edition*

Magazine:

1. *Science and Technology Magazine*
2. *Histograpghy of Contemporary Science and Technology*
3. *Science News Letter*

Journal:

1. *Historiography in Graduate Technology*
2. *Innovation, Technology or History*
3. *Historiography of the Sciences*

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Name of the Module: Basic Civil Engineering
Module Code: CE 201
Semester: 2nd
Credit Value: 3 [P=0, T=0, L=3]

A. Objectives:
The course is design to meet with the following objectives:
1. Increase ability to understand Engineering Drawing.
2. Learn to sketch and take field dimensions.
3. Learn to take data and transform it into graphic drawings.
4. Learn basic engineering drawing formats.
5. Prepare the student for future Engineering positions.

B. Learning Outcome:
Upon completion of the subject, students will be able to:
1. Perform basic sketching techniques will improve.
2. Able to draw orthographic projections and sections.
3. Use architectural and engineering scales will increase.
4. Produce engineered drawings will improve
5. Convert sketches to engineered drawings will increase.
6. Become familiar with office practice and standards.

C. Subject Matter:
Unit I:

      Traditional Materials: stones, bricks, lime, cement, timber. Mortar: sand, cement mortar, mud mortar, special mortar and test on mortar Concrete: plain concrete, reinforced cement concrete, reinforced brick concrete

Unit II:

      Metals as Building materials: Ferrous metals, aluminum, copper. Miscellaneous Building materials: Glass, plastics, bitumen, asbestos, paints, distempers, varnishes, solid and hollow concrete Blocks, Roofing and flooring tile

Unit III:

      Superstructures: Types of superstructure based on the method of load transfer, walls, stone masonry, brick masonry, plastering, pointing, flooring, roof, doors and lintels, stairs.

Unit IV:

      Surveying: Introduction to surveying-Object and uses of surveying, primary divisions of surveying, fundamental principles of surveying, classification of surveying, plans and maps, scales.

D. Teaching/Learning/Practice Pattern:
      Teaching: 40%
      Learning: 10%
      Practice: 50%

E. Examination Pattern:
1. Theoretical Examination: Open book/ Regular examination and on line test.

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F. Reading List:
Books:
1. *Rakesh Roshan Beohar, "Basic Civil Engineering", Laxmi Publications.*
2. *Ramamurtham, "Basic Civil Engineering",Dhanpat Rai and sons ,3rd edition*
3. *S S Bhavikatti "Basic Civil Engineering" New Age international Publishers,1st edition*

Magazine:
1. *Civil Engineering and Construction Review.*

Journals:
1. *ASCE.*
2. *Springer.*

Name of the Module: Workshop Practice II
Module Code: ME 202
Semester: 2nd
Credit Value: 2 [P=3, T=0, L=0]

A. Objectives:
The course is design to meet with the following objectives:
1. To acquire skills in basic engineering practice.
2. To identify the hand tools and instruments.
3. To acquire measuring skills.
4. To acquire practical skills in the trades.
5. To acquire practical skills in welding, carpentry, fitting.

B. Learning Outcome:
Upon completion of the subject, students will have knowledge of:
1. Handling of tools and machine and understanding of workshop safety.
2. Working principle of different tools.
3. Practical experimentation on different welding types.
4. Preparation of different carpentry joints.

C. Subject Matter:
Unit I:
> **Bench work and Fitting:** Tools for laying out, chisels, files, hammers, hand hacksaw, their specifications and uses, plumbing, Sheet metal Work.

Unit II:
> **Metal Joining:** Definitions of welding, brazing and soldering processes, and their applications, Oxy acetylene gas welding process, equipment and techniques, Types of flames and their applications, Manual metal arc welding technique and equipment, AC and DC welding, electrodes, constituents and functions of electrodes, Welding positions, Types of weld joint, Common welding defects such as cracks, slag inclusion and porosity.

Unit III:

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Machine Shop: Introduction, Basic Principles of Lathe, Shaper, Milling, Drilling, Grinding, Power Hacksaw, etc.

D. List of Practicals:

1. To practice Gas welding using a 3mm thick mild steel plate. (Welding Shop)
2. To prepare a Lap joint and Butt joint by Gas Welding from 3mm thick mild steel plate (Welding Shop).
3. To practice Manual metal arc welding using a 5mm thick mild steel plate (Welding Shop).
4. To prepare various patterns using wood as a pattern material with the help of specific tools. (Carpentry Shop)
5. To perform various bench working operations like sawing, filling and finishing on a 5mm thick mild steel plate using specific tools (Fitting Shop).
6. To prepare jobs (Square, Angular and Semi Circular grooves) using 5mm mild steel plate using specific tools (Fitting Shop)
7. T-Lap joint and Bridle joint (Carpentry Shop).
8. Gas Welding practice on mild steel flat/sheet upto 3 mm thick.
9. Lap joint by Gas Welding (upto 3mm thick).
10. Manual Metal Arc Welding practice (upto 5mm thick).
11. Pattern Making. (Carpentry Shop)
12. Laying out (bench work); Sawing and Finishing by Filing.

E. Teaching/Learning/Practice Pattern:

Teaching: 20%
Learning: 20 %
Practice: 60%

F. Examination Pattern:

1. Job making.
2. Viva-voce.

G. Reading List:
Books:

2. *M.L. Begeman and B.H. Amstead, "Manufacturing Process" John Wiley, 1968. 8th edition*
3. *W.A.J. Chapman and E.Arnold, "Workshop Technology" Vol. 1, 2 & 3, CRC press Prentice Hall*
4. *B.S. Rghuwanshi, "Workshop Technology" Vol. 1 & 2 – Dhanpat Rai and Sons.*
5. *Hazra and choudhary "Workshop Technology" Vol. 1, 2, Media Promoters*
6. *VirenderNarula "Workshop Technology", S.K.Kataria& Sons ,3rd edition*
7. *Anderson "Shop Theory" Mc Graw Hill.6th edition*
8. *H.S.Bawa, "Carpentry: A complete guide", Tata McGraw Hill.*
9. *R.Little, "Welding & Welding Technology", Tata McGraw Hill.8th edition*
10. *L.M.Gourd, "Principles of welding technology", Edward Arnold Publishers.3rd edition*
11. *R.S.Parmer, "Welding processes and technology" Khanna publication.3rd edition*

Magazines:

1. *International Metal Working News.*
2. *Industrial Distribution*

Journals:

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1. *International Journal of Machine Tools and Manufacture*
2. *Journal of Manufacturing Science and Engineering, Transactions of the ASME*
3. *Journal of Manufacturing Technology and Research*

Name of the Module: Foreign Language (German/Chinese) (Audit)
Module Code: HSS 202
Semester: 2nd
Credit Value: 2 [P=2, T=0, L=0]

A. Objectives:
The course is design to meet with the following objectives:
1. The French Language course accords to a method created for Indian students who are complete beginners in French and who wish to acquire verbal communication skills in current scenario.

B. Learning outcome:
Students successfully completing this module will be able to:
1. Develop four skills in French i.e. Reading, Writing, Speaking, Comprehension.

C. Subject matter:
Unit-I:
Self Introduction, Introducing Friends, Family &person's Topical writing, Essays Description of Persons Place, Things, Class, City, Country, House, Plan a Week-End, Excursion,
Unit-II:
Making Resume, Interviews Letter Writing, Rejecting or accepting proposals, Invitation, Dialogues, Tastes & Preferences.
Unit-III:
Conversational French between Known & Unknown people, Telephonic Conversation with Friends & Client

D. List of Practical:
1. Issue Writing
2. Writing Resumes and Applications
3. Writing Memos
4. Reading Comprehension
5. Vocabulary
6. Presentation Skills
7. Group Discussion
8. Extempore
9. Debates

E. Teaching/ Learning/ Practice Pattern:

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Teaching: 40%
Learning: 10%
Practice: 50%

F. Examination Pattern:
1. Theoretical Examination

G. Reading List:
Books:

      1. *Suggested book-Ailes Volume-II*

Semester- III

Name of the Module: Engineering Mathematics III
Module Code: MAS 311
Semester: 3ʳᵈ
Credit Value: 4 [P=0, T=1, L=3]
Module Leader:

A. Objectives:
The course is design to meet with the following objectives:
1. To study and develop the functions of one complex variable.
2. To perform a thorough investigation of the major theorems of complex analysis: the Cauchy-Riemann Equations, Cauchy's Theorem, Cauchy's Integral Formula, the Maximum Modulus Principle, Liouville's Theorem, the Residue Theorem, Rouche's Theorem, the Riemann Mapping Theorem including their proofs.
3. Apply these ideas to a wide range of problems that include the evaluation of both complex line integrals and real integrals.

B. Learning Outcomes:
Upon completion of the subject, students should understand:
1. How complex numbers provide a satisfying extension of the real numbers.
2. How throwing problems into a more general context may enlighten one about a specific context.
3. The techniques of complex analysis that make practical problems easy.
4. And continue to develop proof techniques.

C. Subject Matter:
Unit I:
    Complex variables: Function, Limit and continuity of complex functions, Differentiation of complex functions, Analytic function, Cancly-Riemann equations, Harmonic functions.
Unit II:

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Line Integrates: Canchy-Gourset theorem (no proof required), Cancly's Integral formula, Derivative of analytic functions, Taylor's and Laurent's series, Zeroes, Singular points, essential and removable, Poles, Residue, Residue Theorem, Contour Integration (simple cases only).

Unit III:

Vector and Euclidean spaces: Linea dependence, Bases, Vector space and subspaces, Point sets, Convex sets, Boundary Points, Extreme points, Linear system – Basic Solutions, Basic matrix, Feasible solution, Basic feasible solution.

Unit IV:

Boundary value and Initial value problems leading to partial differential Equation: Method of solution by separation of variables Technique.

D. Teaching/ Learning/ Practice Pattern:

Teaching: 70%

Learning: 30%

Practice: 0%

E. Examination Pattern:

1. Theoretical Examination.

F. Reading List:

Books:

1. *C. L. Liu, "Elements of Discrete Mathematics",2nd edition MGH.*

2. *B. Kolman, R. C. Busby , S. C. Ross, "Discrete Mathematical Structures",6th edition Pearson Education.*

3. *D.S Malik & M. K. Sen, "Discrete Mathematical Structures: Theory & Applications", Thomson India   Edition.*

4. *T. Veerarajan, "Discrete Mathematics",2nd edition MGH.*

5. *N. Chandrasekaran, M. Umaparvathi, "Discrete Mathematics",2nd edition, PHI Learning Private Limited.*

6. *B. Ram, "Discrete Mathematics", Pearson.*

7. *S. Lipschutz, Marc L. Lipson, "Discrete Mathematics", 1st edition , Schaum's outlines.*

8. *Norman L. Biggs, "Discrete Mathematics", Oxford.*

9. *S. K. Chakraborty, B. K. Sarkar, "Discrete Mathematics",1st edition, Oxford.*

10. *K. D. Joshi, "Applied Discrete Structures",1st edition, New Age International Publishers.*

Magazines:

1. *Current Science (Indian Academy of Science).*

2. *The Mathematics Student (Math Student) (Indian Mathematical Society).*

3. *Mathematical Spectrum (The University of Sheffield).*

4. *Mathematics Magazine (Mathematical Association of America).*

5. *Plus magazine (University of Cambridge).*

6. *Ganithavahini (Ramanujan Mathematical Society).*

7. *Mathematics Today, London Metropolitan University.*

Journals:

1. *SIAM Journal on Discrete Mathematics.*

2. *Open Journal of Discrete Mathematics.*

3. *Discrete Mathematics, Elsevier.*

4. *Journal of Discrete Mathematics, Hindawi Publishing Corporation.*

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Department of Mechanical Engineering

Name of the Module: Basic Thermodynamics
Module Code: ME 301
Semester: 3rd
Credit Value: 5[P=2, L=3, T=1]
Module Leader:

A. Objectives:

The course is designed to meet with the following objectives:
1. Understand basic definitions and terminology.
2. Identify special definitions from the thermodynamics point of view.
3. Discover why and how natural processes occur only in one direction unaided.
4. Understand the concept of property and how it defines a state.
5. Identify the change of state results in a process.
6. Determine why processes are required to build cycles.
7. Recognize the differences between work producing and work consuming cycles.

B. Learning Outcome:
Upon completion of the subject, the students should be able to:
1. Understand of the first and second laws of thermodynamics and their application to a wide range of systems.
2. Apply the basic laws of thermodynamics in various thermodynamic systems.
3. Evaluate entropy changes in a wide range of thermodynamic processes.
4. Analyse properties of pure substances for engineering applications

C. Subject Matter:
Unit I:
   Review of Fundamental Concepts: Systems and control volumes; State and equilibrium, processes and cycles, Zeroth law, Forms of energy, Energy transfer by heat and work.
   First Law of Thermodynamics: First Law applied to Non-flow and Flow Processes, Concepts of internal Energy, Enthalpy, Specific Heats, PMMI, Energy Equations for Flow Systems, and application of Energy Equations to different Engineering Components.
   Second Law of Thermodynamics: Need of the Second Law, Preliminary definitions, Different statements of the Second Law of Thermodynamics and their equivalence, Reversibility and Irreversibility, Causes of Irreversibility, Reversible Cycles, Carnot Theorem, Absolute Thermodynamic Temperature Scale.
Unit II:
   Entropy: Clausius Theorem and Inequality, Entropy Principle, Entropy and Disorder, Evaluation of Entropy changes during various processes, T-s and h-s diagrams, Concept of Third Law of Thermodynamics, Entropy changes for flow process.
Unit III:
   Properties of Substances: Gases- Equation of state of an Ideal Gas, Specific Heats, Internal Energy, Enthalpy and Entropy change of Ideal Gases. Equation of state of Real Gases, Principle of corresponding state, Compressibility Factor, Steam- Definition of Sensible Heat, Latent Heat, Saturation Temperature, Quality, Evaluation of Properties from Steam Table and Mollier Diagram.
Unit IV:

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Auxiliary Functions: Availability of Non-Flow as well as Flow Processes, Gibb's Function, Helmholtz Function, Maxwell Relation, T-ds Equations, Clapeyron Equation, Concept of energy, Joule Kelvin effect, C_p, C_v relation in terms of P,V, T.

D. List of Practical:

1. Study of various parts of a 4-stroke Petrol Engine along with their significance.
2. Study of various parts of a 2-stroke Petrol Engine along with their significance and compare it with a 4 stroke petrol engine.
3. Study of various parts of a 4-stroke CI engine along with their significance and point out the differences between a SI engine and CI engine.
4. Study of various parts of a Cochran Boiler along with their significance.
5. Study of various parts of a Babcock-Wilcox Boiler along with their significance.
6. Study the use of a Planimeter and also learn to calibrate it.
7. Study the use of a Vacuum gauge and also learn to calibrate it.

E. Teaching/Learning/Practice Pattern:

Teaching: 60 %
Learning: 30 %
Practice: 10%

(Teacher is to divide components for T/R/P)

F. Examination Pattern:

1. Theoretical Examination.
2. Practical Examination.

G. Reading List:
Books:

1. *P. K. Nag, "Engineering Thermodynamics", TMGH, 4th Edition, 2011.*
2. *Y. A. Cengel and M. A. Boles, "Thermodynamics - An Engineering Approach", TMGH, 5th Edition, 2006.*
3. *G. F. C. Rogers and Y. R. Mayhew, "Engineering Thermodynamics", Pearsons, 5th Edition.*
4. *Zemansky, "Heat and Thermodynamics", MGH.*
5. *R. E. Sontag C. Borgnakke and G. J. Van Wylen, "Fundamentals of Thermodynamics",8th edition Wiley.*
6. *R. K. Bansal, "Thermal Engineering",3rd edition, Laxmi Publication.*
7. *L. D. Russel, G. A. Aderbiyi, "Engineering Thermodynamics", Oxford Publication.*

Magazine:

1. *Cosmos.*
2. *Discover.*
3. *Every day Science.*
4. *Process cooling.*
5. *Forge.*

Journals:

1. *Journal of Thermodynamics.*
2. *Journal of Thermodynamics and Catalysis.*
3. *The Journal of Chemical Thermodynamics – Elsevier.*

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4. *Journal of Thermodynamics & Catalysis - OMICS Group.*

Name of the Module: Material Sciences & Engineering
Module Code: ME 302
Semester: 3ʳᵈ
Credit Value: 3 [P=0, T=0, L=3]
Module Leader:

A. Objectives:
The course is designed to meet with the following objectives:
1. Know the fundamental science and engineering principles relevant to materials.
2. Understand the relationship between microstructure, properties and processing.
3. Have the experimental skills for a professional career or graduate study in materials.
4. Design and selections of materials for specific application.
5. Be able to communicate effectively, to work in teams and to assume positions as leaders.

B. Learning Outcome:
Upon completion of the subject, the students should be able to:
1. Have a thorough knowledge regarding various metals and their crystal structure.
2. Select materials; design the heat treatment for specific needs.
3. Correlate the heat treatment to the microstructure and mechanical properties of industrial alloys.
4. Decide the processing condition of alloys based on phase diagram.

C. Subject Matter:
Unit I:
   Crystal Structure: Unit cells, the face centred cubic crystal structure, the body centred cubic crystal structure, and the hexagonal close packed structure, Crystallographic directions and planes, Determination of crystal structures, Crystal defects.
Unit II:
   Mechanical Properties of Metal: Concepts of stress and strain, Tension tests, Compression and Shear tests, Elastic deformation- Stress-Strain behaviour, Plastic deformation, Tensile properties, Yielding and yield strength, Ductility, Toughness, True stress and strain, Elastic recovery during plastic deformation, Creep , Fatigue, Proof stress.
Unit III:
   Stability of Phases and Equilibrium: Liquid solid transition, Phase equilibrium diagrams, Cooling curves, The liver rule, Iron-Iron carbide equilibrium diagram, TTT diagram. Crystallization, Nucleation, Homogeneous nucleation, Heterogeneous nucleation, Crystal growth, Full annealing, Spheroidizing, Normalizing, the isothermal transformation diagram, Continuous cooling transformation diagram, Tampering, Hardenability, application of heat treatment for gear, thread etc.
Unit-IV:
   Cast Iron: Classification of CI, production of various types of cast iron and their applications, brief introduction of alloys, their uses and application, Composite materials, ceramic materials, polymer, and corrosion.

D. Teaching/Learning/Practice Pattern:
   Teaching: 60 %
   Learning: 40%
   Practice: 0%

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(Teacher is to divide components for T/R/P)

E. Examination Pattern:
    1. Theoretical Examination.

F. Reading List:
Books:
1. Y. Lakhtia, "Engineering Physical Metallurgy" 1st edition ,Mir Publishers, Moscow.
2. A. G. Guy, "Physical Metallurgy Principle",2nd edition, MGH.
3. S. H. Avner, "Introduction to Physical Metallurgy", 2nd edition,TMGH.
4. Boothroyd, "Fundamental of Metal Machining and Machine tools"3rd edition, TMGH.
5. P. N. Rao, "Manufacturing Technology (Vol I & II)",2nd edition, TMGH.
6. P. C. Pandey & C. K. Singh, "Production Engineering Sciences",1st edition, Standard Book Publishers.
7. B. S. Raghuwanshi, "A Course in Workshop Technology", 2nd edition,Dhanpat Rai & Sons.
8. Chapman and Martin, "Workshop Technology", Viva Book Pvt. Ltd.
9. M. L. Begeman and B.H. Amstead, "Manufacturing Process",1st edition, John Wiley.

Magazine:
1. Material Today.
2. Discover.

Journals:
1. Journal of Materials Science.
2. Advanced Composite Materials.
3. Applied Materials & Interfaces.
4. Materials Science and Engineering.
5. Journal of Tribology.

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Name of the Module: Strength of Materials
Module Code: ME 303
Semester: 3rd
Credit Value: 5 [P=3, T=0, L=3]
Module Leader:

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A. Objectives:
The course is designed to meet with the following objectives:
1. To establish an understanding of the fundamental concepts of mechanics of deformable solids; including static equilibrium, geometry of deformation, and material constitutive behavior.
2. To understand and apply for evaluation of stress and deformation in simple geometries such as bars, beams, shafts, for various types of load conditions.
3. To build the necessary theoretical background to be utilized in design courses.

B. Learning Outcome:
Upon completion of the subject, the students should be able to:

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1. Have the basic concepts on various loadings and their effects on different elements.
2. Be able to analyse simple geometries subjected to tension, compression, torsion, bending and combined stresses using the fundamental concepts of stress, strain and elastic behaviour of materials.
3. Be able to evaluate strain and deformation that will result due to internal stress developed under simple load conditions.
4. Be able to apply the knowledge in designing machine parts and structures to prevent failure.

C. Subject Matter:

Unit I:

Simple stresses and strains: Stress, strain, types of stresses, elastic limit, Hook's law, Analysis of bars of varying sections, law of superposition, composite bar, thermal stress, thermal stresses in composite bars, elongation of bar due to its own weight, stress-strain diagram.

Elastic constants: Introduction, longitudinal & lateral strain, Poisson's ratio, volumetric strain for rectangular bar, Bulk Modulus, Principle of complementary shear stress, Relation between various elastic constants.

Unit II:

Principle stresses and strain: Introduction, Principle planes and principle stresses, methods for determining stresses on oblique section, Analytical method, Graphical method, Mohr's circle, use of Mohr's circle to find Principle stresses.

Strain Energy and Impact Loading: Introduction, Resilience, proof resilience, Modulus of Resilience, expression for strain energy stored in a body for different loading conditions and shear stress.

Unit III:

Shear force and Bending moment: Introduction, different types of beams and loads, S.F & BM diagram for a cantilever, Uniformly distributed load, Simply supported beam for various types of loading, relation between load, shear force and Bending moment diagram.

Torsion of shafts: Introduction, Basic assumptions, Derivation of shear stress produced in a circular shaft subjected to torsion, Maximum torque transmitted by acicular and hollow circular shaft, Polar modulus, strength of a shaft and tensional rigidity, composite shafts, combined bending and torsion, Strength of a shaft of varying cross section, Buckling vertical column, slenderness ratio.

Unit IV:

Thin and Thick cylinder: Introduction, Thin cylindrical vessel subjected to internal pressure, expression for circumferential and longitudinal stress in thin cylinder, stresses in thick cylindrical shells, stresses in compound thick cylinder.

D. List of Practical:

1. To determine hardness of material with the help of various methods such as Rockwell, Brinell and Vickers tests.
2. To determine the impact strength of materials with the help of pendulum type impact testing machine.
3. To determine tensile properties of ductile material with the help of Universal testing machine (UTM).
4. To determine the compressive properties of non-ductile materials with the help of UTM.
5. To determine the compressive strength of brittle materials with the help of compressive testing machine.
6. To perform various types of non-destructive tests and thus obtain various properties of materials.
7. To determine the creep and fatigue of a material using Creep testing and Fatigue testing machine.

E. Teaching/Learning/Practice Pattern:

Teaching: 60 %

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Learning: 20 %
Practice: 20%

(Teacher is to divide components for T/R/P)

F. Examination Pattern:
1. Theoretical Examination.
2. Practical Examination.

G. Reading List:
Books:
1. S. Timoshenko, "Strength of Materials", D. Van Nostrand Company Inc, 3rd Edition.
2. S. Timoshenko & D. H. Young, "Elements of Strength of Material", D. Van Nostrand Company Inc, 4th Edition.
3. S. Ramamrutham , "Strength of materials", 18th edition,Dhanpat Rai Publishing Company.
4. R. K. Bansal, "A Text Book of Strength of Materials",1st edition Laxmi Publications Pvt. Ltd.
5. L. C. Singal and N. D. sharma, "Strength of Materials", Modern Publishers.
6. S. Subramanian, "Strength of Materials", Oxford University Press.
7. Beer and Johnson, "Mechanics of Materials", TMGH.
8. S. S. Rattan, "Strength of materials", TMH, 2nd Edition.
9. G. H. Ryder, Mc Millan, "Strength of Material",3rd edition ELBS Edition.
10. Nash, "Strength of Materials", Schaum series,6th edition , MGH.

Magazine:
1. Popular Mechanics.
2. Everyday Engineering Magazine.

Journals:
1. Engineering Fracture Mechanics.
2. International Journal of Fracture.
3. Strength of Materials, Springer.
4. Strength of Materials, Elsevier.

Name of the Module: Fluid Mechanics I
Module Code: ME 304
Semester: 3rd
Credit Value: 5 [P=3, T=0, L=3]
Module Leader:

A. Objectives:
The course is designed to:
1. Illustrate the properties of fluids and the applications of fluid mechanics.
2. Understand the fundamental of kinematics and dynamics of fluid flows and the governing non-dimensional parameters of a fluid element.
3. Apply the concepts of mass, momentum and energy conservation to flows.

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4. Describe the fundamentals of incompressible viscous flow, various flow measurement devices and boundary layer concept.
5. Solve the varieties of simplified problems analytically.

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B. Learning Outcome:

Upon completion of the subject, the students should:

1. Understand the basics physics of fluid statics, kinematics and dynamics.

2. Describe the fundamentals of incompressible viscous flow, various flow measurement devices and boundary layer concept.

3. Analyze fluid flow problems with the application of the mass, momentum and energy equations.

4. Apply principles of dimensional analysis and similitude to simple problems and use dimensionless parameters.

C. Subject Matter:

Unit I:

Hydrostatics: Total pressure and centre of pressure for horizontal, vertical, inclined plane surfaces and curved surfaces submerged in liquid, total pressure and centre of pressure on lock gates.

Buoyancy and flotation: Buoyancy, centre of buoyancy, metacentre and metacentre height and equilibrium of floating bodies, period of oscillation, Types of fluid flow, streamline with equation, streak line, path line, translation, rotation, deformation, Kinematics of flow, continuity equation in three dimensions, velocity potential function and stream function, forced and free vortex flow.

Unit II:

Dynamics of flow: Euler's equation and Bernoulli's equation, application of Bernoulli's equation venturi-meter, orifice-meter, and pitot tube.

Orifice and Notches: Flow through orifices, hydraulic coefficients, time of emptying hemispherical and horizontal cylindrical tank through an orifice at its bottom, Discharge over rectangular, triangular and trapezoidal notches, velocity of approach, rectangular, triangular and trapezoidal notches, velocity of approach.

Laminar flow: Flow of viscous fluid through circular pipe-velocity distribution and average velocity, Hagen Poiseiulle formula, Kinetic energy correction and Momentum Correction factors, Navier-Stokes equation of motion.

Turbulent Flow: Reynold's experiment, Loss of head due to friction in pipes, Reynold's expression and Prandtl mixing length theory for turbulent shear stress.

Unit III:

Flow through Pipes: Major and minor losses of energies in pipes, Hydraulic gradient and total energy lines, flow through pipes in series, equivalent pipe, Flow through parallel pipes, Power transmission through pipes and nozzles, water hammer.

Flow in open channel: Uniform flow through open channels, Chezy's formula, and most economical sections of channel, Non-uniform flow-specific energy and specific energy curve, critical depth and critical velocity, minimum specific energy, hydraulic jump.

Unit IV:

Dimensional and Model Analysis: Dimensions of fundamental and derived quantities, Dimensional Homogeneity, Reyleigh's method and Buckingham's pie-theorem, dimensionless, Model Laws, classification of models.

D. List of Practical:

1. To perform an experiment to verify Bernoulli's equation and thus explain its use and importance.
2. To determine the co-efficient of friction in pipes.
3. To determine co-efficient of contraction due to sudden contraction in pipes.
4. To determine loss of head due to sudden enlargement in pipes.
5. To determine co-efficient of discharge of venturi-meter.

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6. To determine co-efficient of discharge of Orifice-meter.

E. Teaching/Learning/Practice Pattern:
Teaching: 60 %
Learning: 20 %
Practice: 20%

(Teacher is to divide components for T/R/P)

F. Examination Pattern:
1. Theoretical Examination
2. Practical Examination

G. Reading List:
Books:
1. F. M. White, "Fluid Mechanics", TMGH.
2. R. W. Fox, A. T. McDonald and P.J. Pritchard, "Introduction to Fluid Mechanics", John Wiley.
3. B. R. Munson, D. F. Young and T.H. Okhiishi, "Fundamentals of Fluid Mechanics",6th edition Wiley.
4. J. F. Douglas, J. M. Gasiorek, J. A. Swaffield and L. B. Jack, "Fluid Mechanics", Pearson Education.
5. Y. A. Cengel and J. M. Chimbala , "Fluid Mechanics: Fundamentals & Applications",1st edition, TMGH.
6. S. K. Som and G. Biswas, "Introduction to Fluid Mechanics and Fluid Machines",2nd edition, TMGH.
7. R. K. Bansal , "Fluid Mechanics & Hydraulic Machines", Laxmi Publications.
8. Streeter and Willy, "Fluid Mechanics", MGH.
9. B. S. Massey, "Mechanics of Fluid", Van Nostrand .
10. K. L. Kumar, "Engineering Fluid Mechanics", Eurasia Publishing House.

Magazine:
1. Pumps & Systems.
2. World Pumps.
3. Hydraulics & Pneumatics.

Journals:
1. International Journal of Heat and Fluid Flow.
2. ASME Journal of Fluids Engineering.
3. Experiments in Fluids.
4. Experimental Thermal and Fluid Science.

Name of the Module: Workshop Practice III

Module Code: ME 351

Semester: 3rd

Credit Value: 2 [P=3, T=0, L=0]

Module Leader:

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A. Objectives:
The course is designed to meet with the following objectives:
1. To acquire skills in basic engineering practice.
2. To identify the hand tools and instruments.
3. To acquire measuring skills.
4. To acquire practical skills in the trades, and
5. To acquire practical skills in welding.

B. Learning Outcome:
Upon completion of the subject, the students should have the knowledge of:
1. Workshop safety.
2. Handling workshop tools, machines.
3. Different welding types.
4. Different carpentry joints, and
5. Different tools working principle.

C. Subject Matter:
Unit I:

   Machine Shop: Introduction to the machine tools (lathe, shaper, planer, drilling etc)**, i**ntroduction to cutting tool, and properties of different materials used in cutting tool, Method of metal cutting.

Unit II:

   Fitting Shop: Introduction, use of precision tools & jobs, to make a fitting as per drawing.

Unit III:

   Sheet Metal Shop: Introduction to sheet metal tools**,** Sheet metal operation - cutting, notching, soldering and brazing.

   Fabrication of: (a) square tin, (b) round tin with lid, (c) "T" pipe joint (d) waste paper basket, (e) measuring jar etc.

   Forging Shop: Introduction to tools & equipment**,** hand forging & machine forging**,** forging operation, defects in forgings.

Unit IV:

   Moulding Shop: Introduction of moulding tools & equipment**,** moulding making**,** Melting of metals - Advantages of casting & casting defects.

   Casting techniques Job: (a) to prepare a sand mould, using the single piece pattern Spilt pattern/ loose piece pattern/pattern with core etc.

   Welding Shop: Introduction of welding equipments and safety measures, Different joint of welding & their use, Welding process, Different types of electrode, fluxes & their uses, Practice on setting welding equipment, gas welding & cutting practice, preparation of simple structures Job, different types of welding joint (lap joint, butt joint, single 'v' grove joint).

D. List of Practical:
1. To practice Gas Welding on a mild steel sheet 3 mm thick.
2. To prepare a Lap joint by Gas Welding on a 3mm thick mild steel sheet.
3. To practice Manual Metal Arc Welding on a 5mm thick mild steel plate.
4. To practice Tungsten Inert Gas Welding (TIG welding) on a 5mm thick mild steel plate.
5. To practice Metal Inert Gas Welding (MIG welding) on a 5mm thick mild steel plate and differentiate between TIG and MIG welding processes.
6. To prepare a pattern using specific tools and learn Pattern Making process and importance.

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7. To prepare a ball peen hammer from a cylindrical workpiece by bench work processes using specific tools (Files, hammer, etc).

8. To perform specific operations like turning, facing, chamfering and knurling on a cylindrical job using Centre Lathe.

E. Teaching/Learning/Practice Pattern:

Teaching: 20 %
Learning: 10 %
Practice: 70 %

(Teacher is to divide components for T/R/P)

F. Examination Pattern:
1. Viva.
2. Job Making.

G. Reading List:
Books:
1. *M. L. Begeman and B. H. Amstead, "Manufacturing Process",5th edition John Wiley.*
2. *W. A. J. Chapman and E. Arnold, "Workshop Technology" Vol. 1, 2 & 3,MPP. 5th edition*
3. *B. S. Raghuwanshi, "Workshop Technology" Vol. 1 & 2,Dhanpat Rai and Sons.*
4. *Hazra and Choudhary, "Workshop Technology" Vol. 1, 2, Media Promoters.*
5. *Y. Lakhtia, "Engineering Physical Metallurgy" Mir Publishers.*
6. *A. G. Guy "Physical Metallurgy Principle",4th edition, MGH.*
7. *S. H. Avner, "Introduction to Physical Metallurgy",2nd edition, TMGH.*
8. *Boothroyd, "Fundamental of Metal Machining and Machine Tools", 3rd edition TMGH.*
9. *P. N. Rao, "Manufacturing Technology (Vol I & II)",2nd edition , TMGH.*
10. *P. C. Pandey & C. K. Singh, "Production Engineering Sciences", Standard Book Publishers.*
11. *Chapman and Martin, "Workshop Technology", Viva Book Pvt. Ltd.*

Magazine:
1. *International Metal Working News.*
2. *Industrial Distribution.*

Journals:
1. *International Journal of Machine Tools and Manufacture.*
2. *Journal of Manufacturing Science and Engineering, Transactions of the ASME.*
3. *Journal of Manufacturing Technology and Research.*

Name of the Module: Behavioural Science
Module Code: HSS 301
Semester: 3rd
Credit Value: 2 [P=0, T=0, L=2,]
Module Leader:

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A. Objectives:

The course is design to meet with the following objectives:

1. Imparting theoretical lectures with case discussion.
2. Providing teaching with inclusive learning.
3. Making students aware about the importance of this subject in their future career.

B. Learning Outcomes:

Upon completion of the subject, students will be:

1. Able to work with efficiency as they had knowledge of the subject.
2. Able to perform much better in their workplace.

C. Subject Matter:

Unit I:

Behavioural Science: An overview, definitions, man the critical factor, Behavioural science and its historical development.

Motivation: Nature of drives, needs and motives, work motives, need hierarchy theory and two factor theory of motivation, how to motivate the workers at work, factors effecting the moral of workers.

Unit II:

Industrial Sociology: Concept and Definitions, importance for Engineers, Growth and Criticism of the Haw throne Studies, Nature and scope of Industrial sociology, Industry and Community, Industry and Tradition in India.

Society and Technical Change: Concept of social change, meaning and definitions of social change, nature of social change, factors such as Natural, Cultural, Economic, Planning, Technological, Indian Information Technology Scenario, Effect of Technology on Social Institutions.

Society and Environment: Meaning and Definitions, Characteristics, Classification of Environment, Physical Environment and its Influence, Social Environment and its some basic elements, Environment in Industry, Illumination, Noise, Atmospheric Conditions, Music and Colour.

Unit III:

Groups: Meaning and Definitions, types of Groups, characteristics, functions of formal and informal groups, merits and demerits of in formal groups.

Unit IV:

Human relations: Historical overview, definitions, early and later approaches to human relations, strategies for establishing healthy human relations.

Labour management relations: Industrial relations, meaning, objectives and definitions, Dunlop's theory of industrial relations, Psychological and Gandhian approach to industrial relations, industrial relations in Japan and India, industrial relation in coming years, challenges of coming years, new dimensions of industrial relations, the ways of industrial peace, Trade unions, meaning and definitions, functions of Indian trade Unions, recent emerging trends in Indian trade unions.

D. Teaching/ Learning Pattern:

Teaching: 50%

Learning/ case presentation: 30%

Assignment: 10%

Attendance: 10%

E. Examination Pattern:

1. Theoretical Examination.
2. Class test.

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3. Assignment.

F. Reading List:

Books:
1. *Wendell L. French, "Human Resource Management (4th Ed.)", Proston: Honshto Mittin, 1998.*
2. *H. Fayol, "Industrial and General Administration", Paris: Dunod, 1916.*
3. *Mintzberg, "The Nature of Managerial Works: Upper Saddle River", N. J. Prentice Hall, 1973.*
4. *Fred N. Ker Linger, "Behavioural Research: A conceptual Approach", New York: Holt Rinehart and Winston, 1979*
5. *Milter William R. and Stephen Rollnick, "Motivational Interviews, (3rd ed.)", Sept 7, 2012.*
6. *Daniel Kahnmen, "Thinking Fast and Slow", April 2, 2013.*
7. *Elizabeth D. Hutchison, "Essentials of Human Behaviour", September 3, 2013.*
8. *Susan P. Robbins, Pranal Chatterjee, Edward R. Canda, "Contemporary Human Behaviour Theory", 2013.*

Magazine:
1. *Leadership Quarterly.*
2. *HBR Magazine.*

Journal:
1. *Journal of Behavioural Sciences.*
2. *Behavioural and Brain Sciences.*
3. *Journal of Contextual Behavioural Sciences.*
4. *Harvard Business Review.*

Semester- IV

Name of the Module: Stochastic Processes
Module Code: MAS 401
Semester: 4ᵗʰ
Credit Value: 4 [P=0, L=3, T=1]
Module Leader:

A. Objectives:
The course is design to meet with the following objectives:
1. Imparting theoretical knowledge and practical application to the students in the area of Stochastic Processes.
2. Introducing the basic notions of probability theory and develops them to the stage where one can begin to use probabilistic ideas in statistical inference and modeling, and the study of stochastic processes.
3. Providing confidence to students in manipulating and drawing conclusions from data and provide them with a critical framework for evaluating study designs and results.
4. Injecting future scope and the research directions in the field of stochastic process.

B. Learning outcomes:
Upon Completion of the subject, students will be able to:

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1. Add new interactive activities to fill gaps that we have identified by analysing student log data and by gathering input from other college professors on where students typically have difficulties.
2. Add new simulation style activities to the course in Inference and Probability.
3. Substantially prepare them to take up prospective research assignments.

C. Subject Matter:

Unit I:

Theory of Probability: Random Experiment**,** Sample space, Random Events, Probability of events, Axiomatic definition of probability, Frequency Definition of probability, Finite sample spaces and equi-probable measure as special cases, Probability of Non-disjoint events (Theorems), Counting techniques applied to probability problems, Conditional probability, General Multiplication Theorem, Independent events, Bayes' theorem and related problems.

Random variables: discrete and continuous, Probability mass function, Probability density function and distribution function.

Distributions: Binomial, Poisson, Uniform, Exponential, Normal, t and χ2, Expectation and Variance (t and χ2 excluded), Moment generating function, Reproductive Property of Binomial, Poisson and Normal Distribution (proof not required), Transformation of random variables (One variable), Chebychev inequality (statement) and problems.

Unit II:

Approximation Theory: Binomial approximation to Poisson distribution and Binomial approximation to Normal distribution (statement only), Central Limit Theorem (statement), Law of large numbers (Weak law), Simple applications.

Unit III:

Sampling Theory: Population, Sample, Statistic, Estimation of parameters (consistent and unbiased), Sampling distribution of sample mean and sample variance (proof not required).

Estimation Theory: Point estimate, Maximum likelihood estimate of statistical parameters (Binomial, Poisson and Normal distribution), Interval estimation.

Testing of Hypothesis: Simple and Composite hypothesis, Critical Region, Level of Significance, Type I and Type II Errors, Best Critical Region, Neyman-Pearson Theorem (proof not required), Application to Normal Population, Likelihood Ratio Test (proof not required), Comparison of Binomial Populations, Normal Populations, Testing of Equality of Means, χ2—Test of Goodness of Fit (application only).

Unit IV:

Correlation and Regression: Simple idea of Bivariate distribution, Correlation and Regression and simple problems.

D. Teaching/Learning/Practice Pattern:

Teaching: 70%
Learning: 30%
Practice: 0%

(Teacher is to divide components for T/R/P)

E. Examination Pattern:

1. Theoretical Examination & Open book examination.

F. Reading list:
Books:

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1. *P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal Book Stall, 2000. 1st edition*
2. *Khazanie, Ramakant, Santa Monica," Basic Probability Theory and Applications", CA: Goodyear, 1976.*
3. *Ross, Sheldon M," Introduction to Probability Models", New York, NY: Academic Press, 1972, 1985. Third Edition.*
4. *S. Ross, "A First Course in Probability", 6th Ed., Pearson Education India, 2002.*
5. *Cramer, Harald," Random Variables and Probability Distributions", New York, NY: Cambridge University Press, 1970. Third Edition. 3rd edition*
6. *Parzen, Emanuel," Modern Probability Theory and Its Applications", New York, NY: John Wiley, 1960.*
7. *Rothschild, V. and Logothetis, N, "Probability Distributions", New York, NY: John Wiley, 1986.*
8. *Bailey, Norman T.J," The Elements of Stochastic Processes with Applications to the Natural Sciences", New York, NY: John Wiley, 1990. 1st edition*
9. *Bhat, U. Narayan, "Elements of Applied Stochastic Processes", New York, NY: John Wiley, 1984. Second Edition.*
10. *Karlin, Samuel and Taylor, Howard M, "A First Course in Stochastic Processes", New York, NY: Academic Press, 1975. Second Edition.*
11. *Karlin, Samuel and Taylor, Howard M, "A Second Course in Stochastic Processes", New York, NY: Academic Press, 1981. 1st edition*
12. *J. Medhi, "Stochastic Processes", 3rd Ed., New Age International, 2009.*
13. *Ross, Sheldon M, "Stochastic Processes", New York, NY: John Wiley, 1983.*
14. *N. G. Das, "Statistical Methods", Vol-I & Vol-II, MGH.*
15. *Murray R. Spiegel, "Probability and Statistics", MGH, Schaum's Outline Series.2nd edition*

Magazines:

1. *Current Science (Indian Academy of Science).*
2. *The Mathematics Student (Math Student) (Indian Mathematical Society).*
3. *Mathematical Spectrum (The University of Sheffield).*
4. *Mathematics Magazine (Mathematical Association of America).*
5. *+Plus magazine (University of Cambridge).*
6. *Ganithavahini (Ramanujan Mathematical Society).*

Journals:

1. *Advances in Probability and Related Topics (Marcel Dekker).*
2. *Annals of Applied Probability (Institute of Mathematical Statistics).*
3. *Annals of Probability (Institute of Mathematical Statistics).*
4. *Communications on Stochastic Analysis.*
5. *Electronic Journal of Probability.*
6. *Séminaire de Probabilités (Lecture Notes in Mathematics, Springer-Verlag).*
7. *Stochastic Modelling and Applied Probability (Springer-Verlag).*
8. *Stochastic Processes and their Applications.*
9. *Stochastics: An International Journal of Probability and Stochastic Processes (Taylor & Francis).*
10. *Theory of Probability and its Applications (SIAM).*
11. *Stochastic Processes and their Applications, Elsevier.*
12. *Stochastics: An International Journal of Probability and Stochastic Processes, Taylor Francis Online.*
13. *International Journal of Stochastic Analysis, Hindwai Publishing Corporation.*

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14. *Journal of the American Statistical Association.*
15. *Journal of the Royal Statistical Society, Series A, Statistics in Society.*
16. *Journal of the Royal Statistical Society, Series B, Statistical Methodology.*
17. *Journal of the Royal Statistical Society, Series C, Applied Statistics.*
18. *SANKHA, ISI, Kolkata.*

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Name of the Module: Electrical Machines.

Module Code: EE 400

Semester: 4th

Credit Value: 5[P=3, T=0, L=3]

Module Leader:

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A. Objectives:

The course is design to meet with the following objectives:

1. To understand the basic principle and operation of rotating electrical machines, their classifications, basic efficiency and performance characteristics.
2. To understand the basic configuration of separately excited permanent magnet, shunt and series DC machines.
3. To analyse DC machine under steady state dynamic operation.
4. To understand the basic configuration of synchronous and asynchronous Machine.

B. Learning Outcome:

Upon completion of the subject, students will be:

1. Made familiar with DC/AC Machines used practically, their operating and control characteristics.
2. Well acquainted with the methods of designing of DC/AC machines and modelling.
3. Substantially prepared to take up prospective research assignments.

C. Subject Matter:

Unit I:

   Basic electromagnetic theory.

   Single phase transformer: Basic principle of single phase transformer, equivalent, circuit phasor diagram, test regulation and efficiency and loses in transformer, Auto transformer and Welding transformer.

   3 phase transformer: Basic principle of 3 phase transformer, parallel connection, principle operation, energy conversion and loses in 3 phase transformer.

Unit II:

   DC machines: Basic principle of DC machine, types, winding, generator circuit, armature reaction.

Unit III:

   AC machines: Basic principle of synchronous and asynchronous Machine.

Unit IV:

   Special Machines: Basic principle, types, performance servo and stepper motor.

D. List of Practical:

1. O.C.C of DC Generator.
2. D.C. Shunt generator build up.
3. Load Test on DC Generator

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4. Load Test on DC Motor.
5. Starting, Running and reversing of DC motor.
6. Speed Control of DC motor by field and armature.
7. O.C.T and S.C.T of alternator.
8. V-curve of alternator.

E. Teaching/Learning/Practice Pattern:

Teaching: 60 %
Learning: 20%
Practice: 20%

(Teacher is to divide components for T/R/P)

F. Examination Pattern:

1. Theoretical Examination.
2. Practical Examination.

G. Reading List:
Books:

 1. *Mcpherson, George, "Introduction to Electric Machines and Transformers", John Wiley and Sons, 1980.2nd edition*

2. Nasser Syed A,"Electric Machine and Transformer", New York, Macmillan, 1984.

3. Say, M. G and Taylor E. O, "Direct Current Machines", Second Ed., ELBS, 1985.

4. Say M. G, "Alternating Current Machines", (5thEd.) ELBS, 1986.

5. Fitzgerald, Kingsley C.and Umans, S. D. "Electric Machinery", (5thEd.), MGH Book Co.92,

6. Clayton A. E, "Performance and Design of Direct Current Machines",3rd Ed Pitman1961.

7. DelToro V, "Electrical Machines & Power Systems",1985, PHI,Englewood Cliffs.,1985.6th edition

 Magazine:

1. IEEE Xplore.

2. Electricity Today T & D Magazine.

 Journals:

1. The Journal of the Institute of Electrical and Electronics Engineers, Japan.

2. Electrical Power Systems Research, Elsevier Journal.

3. Energy Conversion, IEEE Journal.

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Name of the Module: Applied Thermodynamics
Module Code: ME 401
Semester: 4th
Credit Value: 4 [P=0, T=1, L=3]
Module Leader:

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A. Objectives:

The course is designed to meet with the following objectives:

1. To learn about gas and vapor cycles and their first law and second law efficiencies

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2. To understand about the properties of dry and wet air and the principles of psychrometry

3. To learn the about reciprocating compressors with and without intercooling

4. To analyze the performance of steam and gas power cycles.

B. Learning Outcome:

Upon completion of the subject, the students should be able to demonstrate:

1. Understand about various practical power cycles and heat pump cycles.

2. Evaluate properties of gas mixtures.

3. Evaluate the performance of steam and gas thermal power cycles.

4. Apply the knowledge of refrigeration systems and psychrometry.

C. Subject Matter:

Unit I:

Ideal gas, properties of gases and mixtures of gases, enthalpy change of Ideal gas, specific heat and entropy of gas mixture, Air standard cycles, Otto, Diesel and Dual cycles, Limited pressure cycle, Brayton cycle, Stirling cycle and Ericsson Cycle.

Unit II:

Reciprocating air compressor, single and multistage, volumetric efficiency, Maxwells equation T-ds equation, Joule-Kelvin effect, Types of equilibrium, phase change, fuel cell, combustion.

Unit III:

Simple vapour cycles, Rankine cycle, actual vapour cycle processes, comparison of Rankine and Carnot cycle, Reheat cycle, Regenerative cycle, Cogeneration, Process heat, Combined gas and vapour power cycles, Binary vapour cycles.

Unit IV:

Reversed Heat engine cycles and heat pump, Bell Coleman cycle, Simple vapour compression refrigeration cycle, Absorption refrigeration, Properties of atmospheric air, Psychometric chart & processes.

D. Teaching/Learning/Practice Pattern:

Teaching: 60%

Learning: 40%

Practice: 0%

(Teacher is to divide components for T/R/P)

E. Examination Pattern:

1. Theoretical Examination.

F. Reading List:

Books:

1. Y. A. Cengel and M. A. Boles, "Thermodynamics - An Engineering Approach", TMGH.8th edition
2. T. D. Eastop and A. McConkey, Applied Thermodynamics for Engineering Technologist, Pearson.5th edition
3. G. F. C. Rogers and Y. R. Mayhew, "Engineering Thermodynamics", Pearsons, 2003.4th edition
4. P. K. Nag, "Engineering Thermodynamics", TMGH.4th edition
5. R. E. Sontag C. Borgnakke and G. J. Van Wylen, "Fundamentals of Thermodynamics",8th edition Wiley.
6. M. M. ElWakil, Power Plant Technology, MGH.

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Magazine:
1. *Cosmos.*
2. *Discover.*
3. *Every day Science.*
4. *Process cooling.*
5. *Forge.*

Journals:
1. *ASME Journal of Energy Resources Technology.*
2. *Applied Thermal Engineering, Elsevier.*
3. *Experimental Thermal and Fluid Science, Elsevier.*
4. *Journal of Thermodynamics and Catalyst.*
5. *International Journal of Thermodynamics.*

Name of the Module: Engineering Materials and Processes
Module Code: ME 402
Semester: 4ᵗʰ
Credit Value: 5 [P=3, T=0, L=3]
Module Leader:

A. Objectives:
The course is designed to meet with the following objectives:
1. Identify the various manufacturing processes.
2. To understand the fundamentals of casting, welding, metal forming and powder metallurgy.
3. Examine the various manufacturing methods encountered in engineering practice.
4. Analyse the effect of process variables to manufacture defect free products.

B. Learning Outcome:
Upon completion of the subject, the students should be able to:
1. Describe the various manufacturing processes.
2. Interpret casting, welding, metal forming and powder metallurgy techniques.
3. Classify the various manufacturing methods encountered in engineering practice.
4. Evaluate the effect of process variables to manufacture defect free products.

C. Subject Matter:
Unit I:
   Powder Metallurgy: Introduction, sintering process, application.
Unit II:
   Casting: various types of patterns and allowances, mould materials and their properties, strength, permeability and hardness, moulding, Basic principles of solidification, Cupola, terminology, Brief descriptions of the special casting processes, shell moulding, investment casting, die casting and centrifugal casting. Casting defects, Design consideration.
Unit III:
   Welding: Joining, TIG, MIG, Electroslag, Submerged, Carbon Arc, Plasma Arc, Resistance, Solid state welding, Welding defects, Dry and wet welding, brazing and soldering.
Unit IV:

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Metal forming processes: Re-crystallisation temperature, hot and cold working, Rolling, forging, drawing, extrusion, metal forming defects, Design consideration.

D. List of Practical:
1. To prepare a sand mould, using single piece pattern.
2. To prepare a sand mould, using split, loose piece pattern with a core.
3. To perform sand testing to determine properties like permeability, clay content, moisture, etc.
4. To perform sand testing to determine green sand and dry sand shear and compressive strength.

E. Teaching/Learning/Practice Pattern:

Teaching: 60%
Learning: 20%
Practice: 20%

(Teacher is to divide components for T/R/P)

F. Examination Pattern:
1. Theoretical Examination.
2. Practical Examination.

G. Reading List:
Books:
1. *Boothroyd, 'Fundamental of Metal machining and machine tools'. MGH. 3rd edition*
2. *P. N. Rao, 'Manufacturing Technology (Vol I & II)', TMGH.3rd edition*
3. *P. C. Pandey & C. K. Singh, 'Production Engineering Sciences', Standard Book Publishers.*
4. *B. S. Raghuwanshi , 'A course in Workshop technology ', Dhanpat Rai & Sons.1st edition*

Magazine:
1. *Processing.*
2. *Infor.*

Journals:
1. *Journal of Materials Engineering and Performance.*
2. *Mineral Processing and Extractive Metallurgy.*
3. *Journal of Engineering Materials and Technology, ASME DC*
4. *Indian Journal of Engineering and Materials Sciences Niscair.*

Name of the Module: Fluid Mechanics II
Module Code: ME 403
Semester: 4th
Credit Value: 5[P=3, T=0, L=3]
Module Leader:

A. Objectives:
The course is designed to :

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1. Understand the concepts of boundary layers and its related equations and also the mechanics of viscous flow about immersed boundaries.
2. Apply the basic law of thermodynamics to a steady flow in a conduit to derive the general one dimensional flow equation.
3. Recognise the isentropic flow and normal shock to some flow systems such as discharge of air from tanks and nozzle configurations.
4. Formulate a general treatment of the common forms of turbomachine, covering basic fluid dynamics and thermodynamics of flow through passages and over surface, with fundamental governing equations.
5. Describe the basic characteristics of radial and axial pumps, turbines and fans with different kinds of working mediums.

B. Learning Outcome:

Upon completion of the subject, students should:

1. Understand the concepts of boundary layers and boundary layer equations.
2. Describe the principles and applications of turbomachinery in modern industry and apply the principles of fluid mechanics to the operation, design, and selection of fluid machinery such as pumps, fans, and turbines.
3. Evaluate the mechanics of viscous flow about immersed boundaries, as it relates to flow separation, wakes, profile drag, drag coefficients and the determination of drag forces exerted on such bodies.
4. Apply the compressible flow analysis to a pipe flow and compute the pressure losses due to friction, area change in the system and assess the performance of the system.

C. Subject Matter:

Unit I:

Boundary Layer Theory: Navier-Stokes equation, Laminar and Turbulent boundary Layer thickness, von Karman's momentum equation, Total drag due to Laminar and turbulent layers on flat plate, separation of boundary layer and it's control.

Unit II:

Forces on submerged bodies: Drag and lift on a stationary body by flowing fluid, expression for drag and lift and dimensional analysis, streamlined and Bluff, Drag on a sphere and cylinder, Terminal velocity of a body, lift on a airfoil. Potential flow: source, sink, doublet, Rankine oval, lift on rotating cylinder.

Unit III:

Compressible flow of Gas dynamics: Thermodynamic relations, continuity equation, Bernoulli's equation and momentum equation, velocity of sound in fluid, Mach no. propagation of pressure waves in a compressible fluid-Machangle, zone of action and silence, stagnation properties, Area-velocity relationship for compressible flow, flow of compressible fluid through nozzles-maximum mass flow rate and its variation, mass flow rate of compressible fluid through venturimeter, pitot-static tube, Normal and oblique shock waves.

Unit IV:

Hydraulic turbines: Impulse and reaction turbines, Pelton, Francis, Kaplan and Propeller turbines, Turbine efficiencies, turbine specific speed.

Pumps: Ducted and open pumps, centrifugal pump, pump efficiency, performance curves, cavitation, net positive suction head, pumps in series and parallel, scaling laws – specific speed, affinity laws. Axial pumps.

D. List of Practical:

1. To determine co-efficient of discharge of flow nozzle meter.
2. To determine co-efficient of discharge of triangular notch and rectangular notch.

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3. To determine impact of jet.
4. To study the characteristics and performance of a Pelton turbine.
5. To study the characteristics and performance of a Francis turbine.
6. To study the characteristics and performance of a Kaplan turbine.

E. Teaching/Learning/Practice Pattern:

Teaching: 70 %
Learning: 20 %
Practice: 10%

(Teacher is to divide components for T/R/P)

F. Examination Pattern:
1. Theoretical Examination.
2. Practical Examination.

G. Reading List:
Books:
1. *S. L. Dixon, '.Fluid Mechanics and Thermodynamics of Turbomachinery', 5th edition ,Butterworth-Heinemann.*
2. *F. M. White, "Fluid Mechanics", 5th edition ,TMGH.*
3. *B. R. Munson, D. F. Young and T.H. Okhiishi, "Fundamentals of Fluid Mechanics",6th edition, Wiley India.*
4. *J. F. Douglas, J. M. Gasiorek, J. A. Swaffield and L. B. Jack, "Fluid Mechanics", Pearson Education.*
5. *Y. A. Cengel and J. M. Cimbala , "Fluid Mechanics: Fundamentals & Applications",3rd rev edition, TMGH.*
6. *S. K. Som and G. Biswas, "Introduction to Fluid Mechanics and Fluid Machines",3rd edition TMGH.*
7. *R. K. Bansal, "Fluid Mechanics & Hydraulic Machines",rev 9th edition, Laxmi Publications.*
8. *K. L. Kumar, "Engineering Fluid Mechanics", Eurasia Publishing House.*
9. *Sayers, A.T., Hydraulic and Compressible Flow Turbomachines, CBLS, 2003.*
10. *Ganesan, V., Gas Turbines, 2nd ed., TMGH, 2003.*

Magazine:
1. *Pumps & Systems.*
2. *World Pumps.*
3. *Hydraulics & Pneumatics.*

Journals:
1. *International Journal of Heat and Fluid Flow.*
2. *Journal of Fluids Engineering .*

Name of the Module: Theory of Machines

Module Code: ME 404

Semester: 4th

Credit Value: 3[P=0, T=0, L=3]

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Module Leader:

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A. Objectives:

The course is design to meet with the following objectives:

1. To learn different Mechanism of Machine.
2. To learn different working principle of various types of Gears, Brakes, Cams.
3. To Learn how to Draw Velocity and Acceleration diagram for kinematics pairs.

B. Learning Outcome:

Upon completion of the subject, students should be able to:

1. Have Basic knowledge on kinematics of various mechanisms to obtain specific motion in Machine.
2. Have Basic understanding of working principle of different types of Gears, Brakes, Cams.
3. Solve and evaluate kinematic parameters with the help of Velocity and Acceleration diagram for kinematics pairs.
4. Use of computerized tools for kinematic analysis of mechanisms.

C. Subject Matter:

Unit I:

Machine and mechanism: Definition, Mechanism and Machine, Link, Kinematic Pair, Degrees of freedom, Kinematic chain, Various types of joints, Degrees of freedom for plain Mechanism, Inversion, Different types of kinematic chain and their inversions.

Unit II:

Velocity and acceleration in mechanism: Analysis of Reciprocating Engine mechanism and Four bar mechanism, Relative velocity method, Velocity and acceleration in Four bar, Slider crank Mechanism, Instantaneous center Method, Kennedy's Theorem, Mechanical Advantage, Corioli's Acceleration Component, Synthesis of Mechanism, Pantograph, Scott-Russel indicator diagram, Daris and Ackermenn steering mechanism, Hook's joint, Belt, Rope and Chain drive.

Unit III:

Brakes and Dynamometers: Introduction, Types of Brakes (Simple Block, Band, Band & Block brake), Breaking of a Vehicle, Dynamometer, Absorption and transmission Dynamometer.

Gears and Gear Train: Introduction, Gear classification and Terminology, Law of Gearing, Velocity of sliding, Forms of teeth, length of Arc & path of contact, Interference, Minimum number of teeth required to avoid interference, Types of Gear Train, Velocity ratio in different Gear train arrangement, Epicyclic Gear train, compound Epicyclic Gear train.

Unit IV:

Cams: Introduction, Types of followers, Cam profile Nomenclature, various types of motion of the follower-Uniform motion, Simple Harmonic, Uniform Acceleration and Retardation, Cycloidal, Cam profile construction for various types of followers.

D. Teaching/Learning/Practice Pattern:

Teaching: 70%
Learning: 30 %
Practice: 0 %

(Teacher is to divide components for T/R/P)

E. Examination Pattern:

1.   Theoretical Examination.

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2.   Assignments.

G. Reading List:
Books:
1. J. *E. Shigley, Jr. J. J. Vicker, 'Theory of Machines and Mechanisms',3rd edition MGH.*
2. *J. S. Rao and R. Y. Dukkipati, 'Mechanism and Machine Theory',2nd edition , Wiley Eastern Ltd.*
3. *S. S. Rattan, 'Theory of Machine',3rd edition, TMGH.*
4. *J. Lal, 'Theory of Machines', Metropolitan Books Ltd.*
5. *J. J. Uicker, Jr. G. R. Pennock & J. E .Shigley, 'Theory of Machines and Mechanisms',2nd edition Oxford University.*
6. *V. P. Singh, 'Theory of Machines', Dhanpat Rai Publishing Company.*

Magazine:
1. *Power Transmission Engineering.*
2. *Gear Technology.*
3. *Gear Solution.*

Journals:
1. *Mechanism and Machine Theory Journal, Elsevier.*
2. *International Journal of Systems Applications, Engineering & Development.*
3. *The International Federation for Theory of Machines and Mechanisms.*

Name of the Module: Machine Drawing
Module Code: ME 451
Semester: 4th
Credit Value: 2[P=3, T=0, L=0]
Module Leader:

A. Objectives:
The course is design to meet with the following objectives:
1. Increase ability to understand Engineering Drawing.
2. Learn to sketch and take field dimensions.
3. Learn to take data and transform it into graphic drawings.
4. Learn basic Auto Cad skills.
5. Learn basic engineering drawing formats.
6. Prepare the student for future Engineering positions.

B. Learning Outcome:
Upon completion of the subject, students will be able to:
1. Learn basic understanding on development of manufacturing drawings
2. Understand tolerance and symbols used for different operations and fit
3. Development of part and assembly drawings of different mechanical systems
4. Utilisation of engineering tools for development of solid models

C. Subject Matter:
Unit I:

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Different sectional views of the Machine parts, Keys, Splines, Couplings and Valves.

Unit II:

Bearing: Sliding and Rolling contact Types, Brackets and Pulleys, Cotter and Knuckle.

Unit III:

Joints: Riveted joints, laminated joints.

Assembly Drawing: Introduction, Types of assembly drawing, valves, different machine parts.

D. List of Practical:
1. Draw the sectional views of different machine parts.
2. Assembly drawing of screw jack, tailstock, valves.
3. To draw Rivets joints lap and butt with zig-zag and chain system.

E. Teaching/Learning/Practice Pattern:

Teaching: 20 %
Learning: 10 %
Practice: 70 %

(Teacher is to divide components for T/R/P)

F. Examination Pattern:
1. Practical Drawing.
2. Assignment.

G. Reading List:

Books:
1. *N. D. Bhatt and V. M. Panchal, "Machine Drawing", 46th edition, Charotar Publishing House Pvt. Ltd.*
2. *K. L. Narayana, 'Machine Drawing',4th edition , New Age.*
3. *K. L. Narayana, 'Production Drawing',3rd edition ,New Age.*

Magazine:
1. *Machine Design.*
2. *Design to Part Magazine.*

Journals:
1. *International Journal of Design Engineering.*
2. *International Journal of Machine Tools and Manufacture, Elsevier.*
3. *Engineering Design Graphics Journal.*

Name of the Module: Entrepreneurship and Innovation
Module Code: HSS 401
Semester: 4th
Credit Value: 3 [P=0, T=0, L=3]

A. Objectives:

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The course is design to meet with the following objectives:

1. Students will be able to involve themselves in the business activities.
2. Students will be able to start innovative practices in their entrepreneurial activities.
3. Students will be able to develop their skills on the traits that they want to carry forward.
4. Students will be able to start activities on Forest based Technology.

B. Learning Outcomes:

Upon completion of the subject, students will be able to:

1. Start their venture more scientifically.
2. Start their venture by linking with the financial institutions.

C. Subject Matter:

Unit I:

Introduction to Entrepreneurship: Meaning, Role of Entrepreneur.

Entrepreneur Process: different approaches, Motivation for becoming an Entrepreneur, SME Concept, its role, status, prospects and policies for promotion of SMEs.

Importance of Entrepreneurship: innovations, Qualities of successful Entrepreneur, Functions of an Entrepreneur, Types of Entrepreneur, Issues & Problems Entrepreneurial Practices.

Unit II:

Importance of Entrepreneurship innovations: Converting Innovation to Economic Value which includes, Growth Strategies, value position, Market Segments, Value Chain Structure, Revenue Model etc., Qualities of successful Entrepreneur, Functions of an Entrepreneur, Types of Entrepreneur and Issues & Problems Entrepreneurial Practices.

Contribution of Entrepreneurs: Towards R&D, creates Wealth of Nation & Self prospect with Challenge.

Entrepreneur Carrier: Different Stages, Entrepreneur Development Programmers (EDPs).

Unit III:

Characteristics of Entrepreneurship: Risk taker, Perceptive, Curious, Imaginative, Persistent, Goal setting and Hardworking, Research & Management Skill, Organising & Controlling, Soft skills and Feasibility.

Women Entrepreneurship: Opportunities, promotion Hurdles and Prospects of women Entrepreneurs, Factors & Models of Entrepreneurial Development.

Social Entrepreneurial Initiative: Solving social Problems, Business plan, Strategic Plan vs Business Plan.

Unit IV:

Forest based Industries: Mobilization of resources from NTFP products, Processing units, Technical and Financial Feasibility study and analysis of projects under self employment scheme including small entrepreneur.

Farm based enterprises for production and post production of Agri-produce:

Crops: Cereals, Legumes, Oilseeds, Horticulture crops, Fruits and vegetables.

Livestock production: Poultry, Fishery, Medicinal and Aromatic plants.

Handlooms & Sericulture: Handicraft, coir, jute & leather, Micro entrepreneurial skills development and good production practices.

D. Teaching/ Learning/ Practice Pattern:

Teaching: 70%
Learning: 30%
Practice: 0%

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Department of Mechanical Engineering

E. Examination Pattern:
1. Theoretical Examination.

F. Reading List:

Books:
1. *V. Desai, Small-Scale Industries and Entrepreneurship. 9th edition ,Himalaya Publishing House, Delhi.*
2. *Kaulgud, Aruna (2003). Entrepreneurship Management.1st edition , Vikas Publishing House, Delhi.*
3. *Cynthia, L. Greene (2004). Entrepreneurship Ideas in Action. Thomson Asia Pvt. Ltd., Singapore.*
4. *Timmons, Jerry A., and Spinelli, Stephen, 2009. New Venture Creation: Entrepreneurship for the 21st Century, 9th Edition, Boston, MA: Irwin McGraw-Hill.*
5. *Entrepreneurship: Successfully Launching New Ventures by Barringer, Pearson 3rd Education Publishing.*
6. *Hisrich, Entrepreneurship,6th edition, Tata McGraw Hill, New Delhi, 2001.*
7. *Donald F. Kuratko, Entrepreneurship: Theory, Process, Practice Cengage Learning. 6th rev edition*

Magazines:
1. *Longe Magazine.*
2. *Home Business Magazine.*
3. *Entrepreneur.*

Journals:
1. *International Journal of Entrepreneurship.*
2. *International Journal of Innovation Management.*
3. *Journal of Small Business and Entrepreneurship.*
4. *Journal of Human Values.*
5. *Journal of Management Research.*

Semester- V

Name of the Module: Machine Design –I
Module Code: ME 501
Semester: 5th
Credit Value: 5[P=3, T=0, L=3]
Module Leader:

A. Objectives:
The course is design to meet with the following objectives:

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To teach the students the basic steps forming the design process and demonstrating the fact that design problems are open-ended, require creativity and involve iterative solutions.

2. To teach the students design methodologies and simple stresses & applicability of factor of safety

3. Will be able to design machine elements based on strength and stiffness

B. Learning Outcome:

Upon completion of the subjects, students will be able to:

1. Will have knowledge on design philosophy, design considerations for machine component design, design principals, material properties, engineering materials, standard and codes

2. Will have basic understanding machine elements subjected to simple stresses for different loading conditions and theories of failure

3. Will be able to apply knowledge in design of temporary joint e.g. cotter joint, knuckle joint, keys, bolted& coupling and permanent joints e.g. riveted and welded joints subjected to static load

4. Will be able to design of machine components like shafts based on strength and stiffness, various springs and power screws.

5. Use of computerized tools for 3D design of machine elements.

C. Subject Matter:

Unit I:

  Introduction: Factor of safety and theory of failure.

  Fundamentals of Machine Design: Design philosophy, various considerations in machine design, design procedure, Common engineering materials and I. S .I. specification on steels.

Unit II:

  Stresses in machine elements: Types of simple stresses, Stress strain relationship.

  Design for Strength: Design for static loading, Stress concentration factors.

  Design for variable loading.

  Fasteners: Types of fasteners, Design of Cotter and knuckle joint, Design of Key.

   Coupling: Types use**,** Design procedure, working principle of rigid and flexible rubber-bushed couplings.

Unit III:

  Design of Permanent Joints: Rivets, Types and use of rivet joint, Types and efficiency, design procedure, Welded joint, Bolted Joint.

  Power Screws: Power Screw, drives and their efficiency, Design of power screws.

Unit IV:

  Design of Shaft: shaft and its design based on strength, Design of shaft for variable load and based on stiffness, combined bending and twisting moment.

  Springs: Introduction to Design of Helical Springs, Design of Helical Springs for Variable Load Design of Leaf Springs.

D. List of Practical:

  1. Design/Drawing of Cotter and knuckle joint.
  2. Design/Drawing of Key.
  3. Design/Drawing of Rivets.
  4. Design/Drawing of Coupling.

E. Teaching/Learning/Practice Pattern:

  Teaching: 60 %

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Learning: 20 %

Practice: 20 %

(Teacher is to divide components for T/R/P)

F. Examination Pattern:
1. Theoretical Examination and Open book examination.
2. Assignment.
3. Practical Drawing.

G. Reading List:
Books:
1. *J. E. Shigley, 'Mechanical Engineering Design' ,th edition ,MGH.*
2. *V. B. Bhandari, 'Design of Machine element', 3ʳᵈ edition, TMGH.*
3. *V. B. Bhandari, 'Introduction to Machine Design',2ⁿᵈ editon, TMGH.*
4. *M. F. Spott, 'Design of machine elements', 8ᵗʰ edition PHI.*
5. *R. L. Nortron,' Design of Machinery', 4ᵗʰ editionMGH.*

Magazine:
1. *Machine Design.*
2. *Design to Part Magazine.*

Journals:
1. *International Journal of Machine Tools and Manufacture.*
2. *International Journal of Design Engineering.*
3. *Journal of Mechanical Design.*

Name of the Module: Internal Combustion Engines

Module Code: ME 502

Semester: 5ᵗʰ

Credit Value: 5[P=3, T=0, L=3]

Module Leader:

A. Objectives:
The subject is designed to meet the following objectives:
1. To learn about various parts associated with IC engines.
2. To understand the basics of IC engines.
3. To understand and analyse combustion and various parameters and variables affecting IC engines.
4. To learn about various systems used in IC engines and the type of IC engine required for various applications.
5. To learn about emission and its control.

B. Learning Outcome:
After studying this course, students will be able to:
1. Understand the basics of IC engines and fuels.
2. Understand Ignition and combustion in SI as well as in CI engine and non-conventional engines.
3. Calculate different performance parameters.
4. Analyse the exhaust emission and learn about its control.

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C. Subject Matter:

Unit 1:

   Introduction to IC Engines: Basic components and nomenclature, engine classification, SI and CI engine, 2- and 4-stroke engines, working principles, Engine performance parameters such as various efficiencies, average piston speed, specific fuel consumptions etc., Review of air standard cycles - Otto, Diesel and Dual cycles.

   Fuel-air cycles and their analysis: Significance of fuel-air cycles, comparison with air standard cycle, variable specific heats, dissociation, effect of operating variables, Actual cycles and their analysis: time loss factor, heat loss factor, exhaust blow down.

Unit II:

   Fuels: Classification and properties, characteristics and rating, alternate fuels. Carburetion– factors affecting carburetion, air-fuel mixture and requirements at different loads and speeds, essential parts of carburetor, calculation of air-fuel ratio, types of carburetor, Mechanical injection systems, requirements and classification, components of injection system, electronic injection systems, Electronic injection systems-MPFI, D-MPFI, L-MPFI systems.

   Ignition Systems: Battery and magneto injection systems, modern ignition systems, firing order, spark advance, ignition timing.

UNIT III:

   In-cylinder Fluid Motions: Turbulence, swirl, tumble, squish, crevice flow and blowby.

   Combustion in SI Engines: Stages of combustion, factors influencing flame speed, rate of pressure rise, abnormal combustion–pre-ignition, detonation, factors causing abnormal combustion, combustion chambers for SI Engines.

   Combustion in CI Engines: Stages of combustion, factors influencing delay period, knocking in CI engine, factors causing abnormal combustion, combustion chamber for CI Engines, comparison of knock in SI and CI engine, combustion chamber types in CI engines.

   Engine Emissions and Control: Emission norms, emission control methods, exhaust gas recirculation etc.

UNIT IV:

   Engine Friction and Lubrication: Functions of lubrication, lubricating systems, properties of lubricants, SAE rating, additives etc.

   Engine Heat Transfer and Cooling: Variation of gas temperature, piston and cylinder temperature distribution, heat transfer, parameters affecting engine heat transfer, need for cooling systems, types of cooling system.

   Supercharging: Types of superchargers, methods and effects of supercharging and turbocharging.

   Two Stroke Engines: Types of two-stroke engines, delivery ratio, scavenging, trapping, charging efficiencies.

   Non-conventional Engines: Introduction to dual fuel and multi-fuel engines, free piston engines, Stirling engines Homogeneous charged compression ignition engines etc.

D. List of Practical:
   1. To study the functioning of injector and injector pump of C. I engine with sketches.
   2. To study the functioning of carburettor of S.I engine with sketches.
   3. To study the functioning of ignition system of SI engine with sketches.
   4. To study the lubrication system of I C engine with sketches.
   5. To study the cooling system of I C engine with sketches.

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6. To find the brake power, brake specific fuel consumption, brake thermal efficiency of CI engine and draw the performance curve.

E. Teaching/Learning/Practice Pattern:

Teaching: 60%
Learning: 20 %
Practice: 20%

(Teacher is to divide components for T/R/P)

F. Examination Pattern:
1. Theoretical Examination.
2. Practical Examination.

G. Reading List:
Books:
1. *W. W. Pulkrabek, "Engineering Fundamentals of the Internal Combustion Engine", PHI.*
2. *J. B. Heywood, "Internal Combustion Engine Fundamentals", MGH.*
3. *Richard Stone, "Introduction to Internal Combustion Engines", SAE.*
4. *R. P. Sharma and M. L. Mathur, 'A Course in Internal Combustion Engines', Dhanpat Rai & Sons.*
5. *V. Ganesan, 'Internal Combustion Engines',TMGH.*
6. *Crouse, Anglin, 'Automotive Mechanics', TMGH.*
7. *Kirpal Singh, 'Automotive Engineering' Vol. I & II, Standards Publishers.*

Magazine:
1. *Model Engine Builder.*
2. *Car and Driver.*
3. *Engine Technology International.*

Journals:
1. *Journal of Engineering and Applied Science.*
2. *International Journal of Power Engineering.*
3. *International Journal of Ambient Energy.*
4. *International Journal of Thermal Science.*
5. *Combustion and Flame, Elsevier.*

Name of the Module: Heat Transfer
Module Code: ME 503
Semester: 5th
Credit Value: 5[P=2, T=0, L=4]
Module Leader:

A. Objectives:
The course is designed to meet the following objectives:

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1. To introduce a basic study of the phenomena of heat and mass transfer.
2. To develop methodologies for solving a wide variety of practical engineering problems.
3. A knowledge-based design problem requiring the formulations of solid conduction and fluid convection.
4. To develop basic understanding of two phase flow heat transfer.

B. Learning Outcome:

Upon completion of the subject, students should be able to:

1. Define the different mode of heat transfer and basic laws of heat as well as mass transfer.
2. Understand the fundamentals of radiative heat transfer.
3. Account for the consequence of heat transfer in thermal analyses of engineering systems.
4. Solve problems involving steady and transient heat conduction in simple geometries.
5. Analyze heat exchanger performance and effectiveness as well as boiling heat transfer.

C. Subject Matter:

Unit I:

Introduction: Various methods of heat transfer, Fourier's, Newton's and Stefan Boltzman's Law, Combined modes of heat transfer, thermal diffusivity, overall heat transfer coefficient.

Conduction: The thermal conductivity of solids, liquids and gases, factor influencing conductivity, measurement, the general differential equation of conduction, One dimensional steady state conduction, linear heat flow through a plane and composite wall, tube and sphere, critical thickness of insulation, Effect of variable thermal conductivity, Conduction with heat sources, heat transfer from rods heated at one both ends, Heat transfer from fins of uniform cross-section, Errors of measurement of temperature in thermometer wells.

Unit II:

Convection (Forced): Introduction, laminar boundary layer equations on a flat plate and in a tube, laminar forced convection on a flat plate and in a tube, simple Reynold's analogy, Dimensional analysis of forced convection and empirical relationship for forced convection.

Convection (Natural): Dimensional analysis of natural convection, empirical relationship for natural convection, Convection with phase change, Description of condensing flow, A theoretical model of condensing flow, Boiling heat transfer, Empirical relationships for convection with phase change.

Heat Exchangers: Different types of heat exchangers, Determination of heat exchanger performance, Heat exchanger transfer units, Analysis restricted to parallel and counter flow heat exchanger, Effectiveness, NTU.

Unit III:

Thermal Radiation: Introduction, absorption and reflection of radiant energy, Emission, Radiosity and irradiation, Black and non-black bodies, Krichoff's law, intensity of radiation, radiation exchange between black surface, geometric configuration factor, grey body relation exchange between surfaces of unit configuration factors, Grey body relation exchange between surfaces of unit configuration factors, Electrical analogy to simple problems, Non-luminous gas radiation, Errors in temperature measurement due to radiation.

Unit IV:

Introduction to Mass Transfer: Mass and mole concentrations, molecular diffusion, eddy diffusion, Molecular diffusion from an evaporating fluid surface, Introduction to mass transfer in laminar and turbulent convection, Combined heat and mass transfer, the wet and dry bulb thermometer.

D. List of Practical:

1. Study of heat transfer through composite wall.
2. Study of heat transfer through lagged pipe.
3. Study of heat transfer through fin.
4. Study of un-steady state of heat transfer.

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5. Study of heat transfer in forced convection.
6. Study of heat transfer in natural convection.
7. Heat transfer study in parallel flow, counter flow heat exchanger walls.
8. Study of heat transfer through fin tube heat exchanger.
9. Heat transfer study shell & tube heat exchanger.
10. Study of critical heat flux in boiling.
11. Determination of Stefan-Boltzmann constant experimentally.

E. Teaching/Learning/Practice Pattern:

Teaching: 60%

Learning: 20 %

Practice: 20 %

(Teacher is to divide components for T/R/P)

F. Examination Pattern:
1. Theoretical Examination.
2. Practical Examination.

G. Reading List:
Books:

1. F. P. Incropera, and D. P. Dewitt, John, 'Fundamentals of Heat and Mass Transfer' ,7th edition, Wiley.

2. J. P. Holman, 'Heat Transfer', MGH.

3. M. N. Ozisik, 'Heat Transfer - A Basic Approach',2nd edition, MGH.

4. Y. A. Cengel, 'Heat Transfer - A Practical Approach', 4th edition ,MGH.

5. R. K. Rajput, 'Heat & Mass Transfer', 4th edition ,Khanna Publishers.

Magazine:

1. Process Cooling.

2. Forge.

Journals:

1. International Journal of Heat and Mass Transfer.

2. International Journal of Heat and Fluid Flow.

3. International Communications in Heat and Mass Transfer.

4. Experimental Thermal and Fluid Science.

Name of the Module: Measurements and Metrology

Module Code: ME 504

Semester: 5th

Credit Value: 4[P=2, T=0, L=3]

Module Leader:

A. Objectives:
The course is design to meet with the following objectives:

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1. To explain basic concepts and definitions of measurement and control.
2. To explain the measurement of different physical quantities.
3. To explain the control systems and related mathematical formulation.

B. Learning Outcome:

Upon completion of the subject, student will be able to:

1. Understand basics of measurement regarding different physical quantity and control system.
2. Explain the accuracy of measuring instruments.
3. Analyze calibration of measuring instruments.
4. Evaluate control system for mechanical components.

C. Subject Matter:

Unit I:

Introduction: Introduction to measurement and measuring instruments, Generalised measuring system and functional elements, units of measurement, Static and dynamic performance characteristics of measurement devices, Calibration , concept of error, sources of error, statistical analysis of errors.

Unit II:

Sensors and Transducers: Types of sensors, types of transducers and their characteristics, Measurement of displacement and angular velocity

Measurement of pressure: Gravitational, Direct acting, elastic and indirect type pressure transducers, Measurement of very low pressure.

Unit III:

Strain Measurement: Types of strain gauges and their working, strain gauge circuits, Temperature compensation, Strain rosettes.

Temperature Measurement: By thermometers, bimetallic, Thermocouples, thermistors and pyrometers.

Measurement of Flow: Obstruction meters, Variable head meters, hot wire and magnetic meters, Ultrasonic flow meters etc.

Unit IV:

Vibration and Noise measurement: Seismic Instruments, Vibration pickups and decibel meters.

Limits, Fits & Tolerance: Introduction to various fits, limits & tolerances, Indian standards of fits & tolerances & grades, gauge design, Taylor's principle of gauge design, wear allowances, measurement of concentricity & loaded surfaces.

D. List of Practical:

1. Use Micrometer for measuring Go-Not Go plug gauge.
2. Use Vernier for measuring piston.
3. Use different angle measuring instruments for measuring taper plug gauge.
4. Measure V Block with the help of Vernier height gauge.
5. Measure V Block by Dial indicator set up.
6. Measure different elements of screw threads.
7. Measure different elements of gear.

E. Teaching/Learning/Practice Pattern:

Teaching: 70%

Learning: 30%

Practice: 10 %

(Teacher is to divide components for T/R/P)

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F. Examination Pattern:
1. Theoretical Examination.
2. Practical Examination.

G. Reading List:
Books:

1. J. P. Holman, Experimental Methods for Engineers,7th edition, MGH.
2. T. G. Beckwith, N. L. Buck and R. D. Marangoni, Mechanical Measurements,3rd edition, Addison-Wesley.
3. E. O. Doebelin, Measurement Systems- Application and Design,6th edition, MGH
4. B. C. Nakra and K. K. Chaudhary, Instrumentation, Measurement and Analysis,3rd edition, TMGH.
5. R. K. Jain, 'Engineering Metrology' Khanna publishers.20th edition
6. D. S. Kumar, 'Mechanical Measurement & Instrumentation'4th editon
7. R. K. Rajput, ' Mechanical Measurement & Instrumentation', S. K. Kataria & Sons .

Magazine:

1. Cal Lab.
2. Gear Solution.
3. Quality Digest.

Journals:

1. The Journal Metrology and Measurement Systems.
2. The Journal of Measurement Science.
3. The International Journal of Metrology.

Name of the Module: Manufacturing Technology
Module Code: ME 505
Semester: 5th
Credit Value: 5 [P=3, T=0, L=3]
Module Leader:

A. Objectives:
The course is design to meet with the following objectives:

1. To understand the concept and basic mechanics of metal cutting.

2. To understand the working of standard machine tools such as lathe, shaping, milling, drilling and allied machines.

3. To understand the concept of abrasive processes and related finishing processes.

4. To understand the basic concepts of non-traditional machining processes.

B. Learning Outcome:
Upon completion of the subject, students will be able to:

1. Understand the basic concepts of manufacturing processes and operations along with non-traditional machining.
2. Understand and compare the functions and applications of different metal cutting tools.
3. Explain the operations and capabilities of machine tools used in manufacturing.

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4. Analyze the different finishing and super finishing processes.

C. Subject Matter:
Unit I:
Classification of metal removing processes and machines.

Mechanics of Metal Cutting: Geometry of single point cutting tool and tool angles, Tool nomenclature in ASA, ORS and NRS and interrelationship, Mechanism of chip formation and types of chips, Chip breakers, Orthogonal and oblique cutting, cutting forces and power required, Theories of metal cutting, Thermal aspects of machining and measurement of chip tool interface temperature, Friction and metal cutting.

Machinability: Concept and evaluation of Machinability, tool life, mechanisms of tool failure, Tool life and cutting parameters, Machinability index, Factors affecting Machinability.

Cutting Fluid: Types, Selection and application methods.

UNIT II:
General Purpose Machine Tools: Constructional, details of lathe, drilling, milling, shaping and planning machines, Tooling, attachments and operations performed , selection of cutting parameters, Calculation of forces and time for machining, Broaching operation.

Capstan and turret lathes: single and multiple spindle automates, operations planning and tool layout.

UNIT III:
Abrasive Processes: Abrasives natural and synthetic, manufacturing nomenclature, Selection of grinding wheels, Wheel mounting and dressing, Machines for surface and cylindrical grinding, their constructional details and processes.

Surface Finishing: Honing, Lapping and super-finishing, polishing and buffing processes, Screw threads and gear manufacturing methods.

UNIT IV:
Non-Conventional Machining: Benefits, general applications and survey of non-conventional machining processes, Mechanisms of metal removal, tooling and equipments, process parameters, surface finishing obtained and specific application of EDM, LBM, EBM, ECM, USM, AJM processes.

D. List of Practical:
1. To calculate the different angles of a single point cutting tool.
2. To determine the feed force, cutting force varying depth of cut, feed and speed using lathe tool dynamometer.
3. To construct a merchant circle.
4. To perform a gear cutting operation on milling machine.

E. Teaching/Learning/Practice Pattern:

Teaching: 60 %
Learning: 30 %
Practice: 20 %

(Teacher is to divide components for T/R/P)

F. Examination Pattern:
1. Theoretical Examination.
2. Practical Examination.

G. Reading List:

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Books:

1. *S. K. Hajra Coudhury and A. K. Hajra Coudhury, 'Elements of Workshop Technology' (Vol. I & II), MPP.*
2. *B. S. Raghuwanshi , 'A course in Workshop Technology' (Vol. I & II), TMGH. .*
3. *P. N. Rao, 'Manufacturing Technology', 3rd edition ,TMGH.*
4. *P. K. Sapra and R. K. Kapur, 'Workshop Technology-I', 1st edition,Vikas Publishing.*
5. *B. S. Nagendra Parashar and R. K. Mittal , 'Elements of Manufacturing Processes',1st edition PHI.*
6. *G. K. Lal, 'Introduction to Machining Science', 3rd edition , New Age International.*
7. *Ghosh & Mallick, 'Manufacturing Science', 2nd edition East West Press.*

Magazine:

1. *International Metal Working News.*
2. *Industrial Distribution.*
3. *Material Today.*
4. *Discover.*

Journals:

1. *International Journal of Machine Tools and Manufacture.*
2. *Journal of Manufacturing Science and Engineering, Transactions of the ASME.*
3. *Journal of Manufacturing Technology and Research.*

Name of the Module: Industrial Engineering & Management
Module Code: ME506
Semester: 5th
Credit Value: 3[P=0, T=0, L=3]
Module Leader:

A. Objectives:

The course is design to meet with the following objectives:

1. To gain an understanding and appreciation of the principles and applications relevant to the planning, design, and operations of manufacturing/service firms.
2. To develop skills necessary to effectively analyze and synthesize the many inter-relationships inherent in complex socio-economic productive systems.
3. To gain some ability to recognize situations in a production system environment that suggests the use of certain quantitative methods to assist in decision making on operations management and strategy.

B. Learning Outcome:

Upon completion of the subject, students will be able to:

1. Identify the core features of the operations and production management function at the operational and strategic levels.
2. Identify and observe the operational research models from the description of a real system.

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3. Illustrate the mathematical tools that are needed to solve optimization problems.
4. Develop an integrated framework for strategic thinking and decision making focusing wealth creation processes.

C. Subject Matter:

Unit I:

Industrial Engineering: Concept of Industrial Engineering, its role & applications, Operation Research.

Work study: time & motion study, Method study , Principles of motion economy, Workplace layout, Stopwatch time study, SIMO chart, Man-machine chart, Therbligs, PMTS, MTM, Work sampling.

Organisation: Organisation structures, Types, Principles of organization structures, Features of various Ownerships, Company formations, its management and finance, Public limited & private limited company.

Unit II:

Material Management: Functions of material management, Inventories- its types, Just In Time (JIT) inventory, Concept of EOQ & EBQ, Simple EOQ model with and without stock outs, Simple EOQ model with varying demand and production, P- type & Q- type of inventory policies, Selective inventory control like ABC, VED, SDE techniques etc.

Production Planning &Control: Functions and role, Value analysis, Exponential smoothing constant and moving average method in demand and production forecasting, Break even analysis.

Unit III:

Quality Management: Quality v/s reliability, Quality maintenance and quality assurance, SQC technique, Acceptance sampling, Concept of TQM, ISO Standards.

Plant Layout: Location factors, Principles and design, Types of layout, Tools & technique.

Plant Maintenance: Break down, Scheduled and Preventive maintenance, Steps in preventive maintenance, TPM concept.

Unit IV:

Operational Research: Concept of O. R, Methods of O.R, Concept of optimization, Linear programming, simplex method Transportation problem, Queuing theory. Decision theory, Integer programming, Revised simplex method, network techniques (PERT & CPM), theory of games, Simulation

D. Teaching/Learning/Practice Pattern:

   Teaching: 70 %
   Learning: 30: %
   Practice: 0 %

(Teacher is to divide components for T/R/P)

E. Examination Pattern:
   1. Theoretical Examination.

F. Reading List:

Books:

   1. *S. K. Sharma, 'Industrial Engineering and Organisation Management' 1ˢᵗ edition, S. K. Kataria & Sons.*
   2. *M. Mahajan, 'Industrial Engineering and Production Management'2ⁿᵈ edition, Dhanpat Rai and Co.*
   3. *S. N. Chary, 'Production and Organisation Management'5ᵗʰ edition, TMGH.*

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4. *M. Mahajan, 'Industrial Engineering and Production Management' 2nd edition, Dhanpat Rai and Co.*
5. *S. N. Chary, 'Problems & Solutions in Production and Operations Management',1st edition, TMH.*
6. *Banga, Khanna, 'Industrial Engineering & Management' 11th edition, Khanna Publishers.*
7. *Martinch, 'Production and Operation Management',1st edition , WSE.*
8. *Ralph M. Barnes, 'Motion and Time Study: Design and measurement of work', 7th edition, Wiley.*

Magazine:
1. *Journal of Operations Management.*
2. *International Journal of Operations and Production Management.*
3. *Operations Management Research.*
4. *Production and Operations Management.*

Journals:
1. *International Journal of Industrial Engineering and Production Management.*
2. *International Journal of Applied Industrial Engineering.*
3. *International Journal of Industrial Engineering & Production Research.*

Semester- VI

Name of the Module: Dynamics of Machinery
Module Code: ME 601
Semester: 6th
Credit Value: 5[P=3, T=0, L=3]
Module Leader:

A. Objectives:
The course is design to meet with the following objectives:

1. To equip the student with fundamental knowledge of dynamics of machines so that student can appreciate problems of dynamic force balance, transmissibility of forces, isolation of systems, vibrations.
2. Develop understanding of dynamic balancing, flywheel analysis, gyroscopic forces and Moments.
3. Develop knowledge of analytical and graphical methods for calculating balancing of rotary and reciprocating masses.
4. Develop understanding of vibrations and its significance on engineering design.

B. Learning Outcome:
Upon completion of the subject, students will be able to:

1. Basic understanding of dynamics in plane motion with force equilibriums
2. Analyse slider crank and other mechanisms based on learnt techniques
3. Understand basic principles of different rotating dynamic bodies.

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4. Understand how to determine the natural frequencies of continuous systems and analyze stability of various systems.

C. Subject Matter:
Unit I:
Flywheel: Dynamic Force and Motion Analysis of Plane Mechanism, Turning Moment Diagram and Fluctuation of Energy, Fluctuation of Speed, Power Smoothening of a Punch Press by Flywheels.
Unit II:
Dynamically Equivalent System Gyroscopes: Gyroscopic Forces and Couples, Gyroscopic Effects in Machines, Stability of a Four Wheel and Two Wheel Drive Vehicle.

Balancing: Dynamics of Rotating Bodies, Unbalance Effects and Balancing of Inertia Forces, Field Balancing and Balancing Machines, Dynamics of Reciprocating Machines with Single Slider, Unbalance in Single Cylinder Engine Mechanisms, Unbalance in Multi Cylinder Engines, In-line, V-twin and Radial Engines, Tractive Force, Swaying Couple, Hammer Blow, Coupled and Uncoupled Locomotive, Balancing Techniques.
Unit III:
Governor: Speed Control By Governors, Dynamics of Governor Mechanisms, Different Types of Governors, Performance Parameter, Governor Effort and Power, Control Force.
Unit IV:
Vibration: Vibration of Mechanical Systems, Types of Vibration, Lumped Parameter Models, Linearization of System Elements, Degrees of Freedom, Types of Restoration and Dissipation Mechanisms, Types of Excitation, Free Undamped Vibration of Single Degree of Freedom Systems, Determination of Natural Frequency, Equivalent Inertia and Stiffness, Energy Method, Phase Plane Representation, Forced Vibration, rotating, unbalanced whirling of shaft and resonance, magnification factor.

D. List of Practical:
1. To study the use and significance of a Gyroscope.
2. To study about reciprocating mass balancing.
3. To study about different profiles of a cam.
4. To study about vibration on a Universal vibration apparatus.
5. To calculate natural frequency of specified object.
6. To study the Governor characteristics (Porter, watt).

E. Teaching/Learning/Practice Pattern:

Teaching: 70 %
Learning: 20 %
Practice: 10 %

(Teacher is to divide components for T/R/P)

F. Examination Pattern:
1. Theoretical Examination.
2. Practical Examination.

G. Reading List:
Books:

1. *S. S. Rattan, 'Theory of Machine', 4th edition, TMGH.*
2. *J. S. Rao, and K Gupta, 'Introductory Course on Theory and Practice of Mechanical Vibration',1st edition, New Age International Pvt. Ltd.*

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3. *W. T. Thomson, 'Theory of Vibration with Applications',5th edition, CBS publishers.*

Magazine:
1. *Sound and vibration.*
2. *Acoustic.*

Journals:
1. *Journal of the Vibration Institute of India.*
2. *Journal of Sound and Vibration.*
3. *Journal of Vibration and Control.*

Name of the Module: Machine Design –II
Module Code: ME 602
Semester: 6th
Credit Value: 4 [P=2, T=0, L=3]
Module Leader:

A. Objectives:
The course is design to meet with the following objectives:
1. To understand the design and analysis of clutches, brakes and fly wheels.
2. To determine the forces on different type of gears for power transmission.
3. To determine the different forces acting on bearings and understanding selection of bearings.

B. Learning Outcome:
Upon completion of the subject, students will be able to:
1. Basic understanding and selection of clutch, brakes and flywheel for power transmission.
2. Study the design process of gears based on the given load conditions.
3. Basic understanding with selection of bearings for a given applications from the manufacturers catalogue.
4. Apply knowledge learnt for design various components for given applications.
5. Use of computerized tools for 3D design of machine elements.

C. Subject Matter:
Unit I:
   Fatigue Consideration in Design: Variable load- basic concept, Patterns of load or stress variations, S-N curve fatigue strength and endurance limit, Factors influencing fatigue, Effect of stress concentration and fatigue stress concentration definition and its estimation from geometric stress concentration factor, Goodman and Soderberg's relations, design for infinite life and finite life, Methods for design of members under combined (steady and variable) loading conditions, Worked out examples on fatigue design problems.
Unit II:
   Design of Gear Tooth: Gears-types and application and gear terminology, Analysis of forces on spur, and helical gears, Bending and contact stress in gear tooth, Lewis equation for design, Dynamic loading and wear-Buckingham equations for design, Force analysis on bevel and worm gears, Design

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approach for bevel gears- equivalent tooth, Design of fixed ratio gear box- general design procedure, Determination of bearing reaction due to gear forces.

Unit III:

Design of Sliding and Journal Bearings: Types of lubrication- hydro dynamic, hydro static and EHD lubrication, Petroff's equation and the bearing characteristic number, Lubrication regimes- boundary and film lubrication, Hydro dynamic bearings- Pressure distribution-eccentricity and minimum film thickness, Reynolds equation, Heat generation and thermal equilibrium.

Unit IV:

Design/analysis of Brakes clutches and fly wheels: Brakes and clutches -need and functioning, Plate clutches- design for uniform pressure and wear, brake-design/analysis, Flywheel- Coefficient of fluctuation of speeds, fluctuation of energy, energy stored in flywheel. Stresses on flywheel ring, arms, Design of shafts, hub and Key, Design of flywheel.

D. List of Practical:
1. Design/Drawing of Gear.
2. Design/Drawing of Gear tooth.

E. Teaching/Learning/Practice Pattern:

  Teaching: 40 %
  Learning: 20 %
  Practice: 40 %

(Teacher is to divide components for T/R/P)

F. Examination Pattern:
  1. Theoretical Examination and Open book examination.

G. Reading List:

Books:
1. *J. E. Shigley, 'Mechanical Engineering Design', 10th edition , MGH.*
2. *V. B. Bhandari, 'Design of Machine element', 3rd edition , TMGH.*
3. *V. B. Bhandari, 'Introduction to Machine Design', 2nd edition, TMGH.*
4. *M. F. Spott, 'Design of machine elements' , 8th edition ,PHI.*
5. *R. L. Nortron,' Design of Machinery', 3rd edition ,MGH.*
6. *Shiegley and Mischke,' Mechanical Engineering Design',3rd edition , MGH.*

Magazine:
1. *Machine Design.*
2. *Design to Part Magazine.*

Journals:
1. *International Journal of Design Engineering.*
2. *Journal of Mechanical Design.*
3. *Journal of Mechanical Design: ASME DC.*
4. *Machine Design – The Journal of Faculty of Technical Sciences.*

Name of the Module: Power Plant Engineering

Module Code: ME 603

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Semester: 6th
Credit Value: 4 [P=2, L=3, T=0]
Module Leader:

A. Objectives:
The course is design to meet with the following objectives:
1. Analysis and preliminary design of the major systems of conventional fossil-fuel steam-cycle power plants.
2. A working knowledge of the basic design principles of nuclear, gas turbine, combined cycle, hydro, wind, geothermal, solar, and alternate power plants.
3. Awareness of the economic, environmental, and regulatory issues related to power generation.

B. Learning Outcome:
Upon completion of the subject, students will be able to:
1. Understand the energy resources and energy conversion methods
2. Determine the efficiency and output of a Rankine cycle, Brayton cycle etc.
3. Calculate the performance of steam and gas turbines with reheat and regeneration, and discuss the performance of combined cycle power plants.
4. Analyse the design of the major components of a conventional or alternate power plant.

C. Subject Matter:
Unit I

Power Plant in General: Introduction to different power plants, Load duration curves, Location of power Plants, Power plant economics and Indian energy scenario.
Steam Power Plant: Review of Rankine and Carnot cycles, Steam power plant appraisal, Deaeration, Typical layout of steam power plant, Efficiencies in steam power plant, Different types of fuel used for steam Generation, Draught system, Classification of boilers, Boiler accessories, Classification of steam turbines and their working, Fluidized bed.

Unit II

Gas Turbine Power Plant: Classification of gas turbine power plants, components of gas turbine plants, Reheat and regeneration cycle, Analysis of open and closed cycles, Centrifugal and axial compressors; Axial and radial turbines, Velocity triangles, work done, stage losses and efficiency, degree of reaction, slip, blockage, efficiency terms etc.
Diesel Electric Power Plants: Application of diesel engines in power field, Advantages and disadvantages of diesel engine power plant, General layout, Performance characteristics, Supercharging.

Unit III

Hydro-Electric Power Plant: Classification of hydro-electric power plant, Site   selection, Elements of hydro-electric power plant, Advantages of hydro-electric power plant, Classification of hydraulic turbines and its selection, Hydrographs, Flow duration curves.
Nuclear Power Plant: Introduction to nuclear engineering, Types of nuclear reactors, Pressurized water reactor, Boiling water reactor, CANDU reactor, Gas-cooled reactor, Liquid metal fast breeder reactor, India's nuclear power programme.

Unit IV

Non- Conventional Power plants: Prospect of renewable energy source, Types of non-conventional power plants, solar plants, Wind power plants, Bio-mass plants, Geo-thermal power plant, Tidal power plant.

D. List of Practical:

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1. Study of a water tube boiler (Babcock Wilcox boiler).
2. Study of a locomotive boiler.
3. Study of a high pressure boiler.
4. Study of boiler accessories.
5. Trial on a boiler and heat balance sheet.
6. Study of boiler mountings.
7. Study and trial on a steam turbine.
8. Study of condensers.
9. Study of condensate and air extraction pumps.
10. Study of steam power plant (Preferable visit of steam power plant).

E. Teaching/Learning/Practice Pattern:

Teaching: 70 %
Learning: 20 %
Practice: 10 %

(Teacher is to divide components for T/R/P)

F. Examination Pattern:
1. Theoretical Examination.
2. Practical Examination.

G. Reading List:
Books:
1. *P. K. Nag, "Power Plant Engineering", 4th edition, TMGH.*
2. *S. C. Arora & S. Domkundwar, "A Course in Power Plant Engineering", 1st edition*
3. *M. M. Elwakil, "Power Plant Technology",1st edition, MGH.*
4. *R. K. Rajput, "Power Plant Engineering",4th edition Laxmi*
5. *Black and Veatch, "Power Plant Engineering", 1st editon ,MGH*
6. *F. T. Morse, "Power Plant Engineering".*

Magazine:
1. *Process News , SEIMENS.*
2. *Plant Engineering.*
3. *Turbomachinery International.*

Journals:
1. *Journal of Energy Engineering, ASCE.*
2. *International Journal of Energy Engineering.*

Name of the Module: Automation and Computerized Manufacturing

Module Code: ME 604

Semester: 6th

Credit Value: 5[P=3, T=0, L=3]

Module Leader:

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A. Objectives:

The course is design to meet with the following objectives:

1. To introduce the students to the basic tools of Computer Aided Design (CAD).
2. To be able to perform all 2D and 3D designs using CAD package.
3. To introduce the students to the standard terminologies, design and operational characteristics of Numerical Control (NC) and Computer Numerical Controlled (CNC) machines.
4. To prepare the students to be an effective user of a CAD/CAM system.

B. Learning Outcome:

Upon completion of the subject, students will be able to:

1. Recognize the geometric transformation techniques in CAD.
2. Distinguish NC, CNC and DNC systems and understand the basic principles of CAM, FMS and CIM.
3. Apply mathematical tools to represent curves and surfaces for engineering applications.
4. Develop manual and APT part programs for various profiles and test the program through simulation.

C. Subject Matter:

Unit I:

Gear Hobbing, Capstan and Turret lathe, Single spindle and multi spindle automatic lathes.

Unit II:

Machining centre, NC, CNC Machines: Types, Axis definition, Tool offset, CNC programming.
Flexible Manufacturing Systems (FMS) and Computer Integrated Manufacturing (CIM): Introduction to FMS, CIM, Types of FMS and CIM, Configuration and application.

D. List of Practical:

CNC-1: CNC Lathe Machine:

1. Understand operation procedures of the machine.
2. Demonstration of operating procedure with the help of a work piece.
3. Understand safety operations.

CNC-2: CNC Milling Machine:

1. Understand operation procedures of the machine.
2. Demonstration of operation procedure with the help of a work piece.
3. Understand safety operations.

CADD lab: Use of solid modelling, design and analysis using softwares like ANSYS, Pro E, CATIA etc.

E. Teaching/Learning/Practice Pattern:

Teaching: 70 %
Learning: 20 %
Practice: 10%

(Teacher is to divide components for T/R/P)

F. Examination Pattern:

1. Theoretical Examination.
2. Practical Examination.

G. Reading List:

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Books:
1. *Y. Koren , "Computer Control of Manufacturing System", 1st edition ,TMH.*
2. *Barry Leatham, "Introduction to Computer Numerical Control",1st edition, Pittam Publishers.*
3. *T. K. Kundra, P. N. Rao and N. K. Tiwari, "Numerical Control and Computer aided manufacturing",1st edition, TMGH, New Delhi.*
4. *M. P. Groover, "Automation, Production system & Computer integrated manufacturing system", PHI.*
5. *J. E. Shigley, "Mechanical Engineering Design", McGraw-Hill.*
6. *V. B. Bhandari, "Design of Machine Element", TMGH.*
7. *V. Laxminarayanan & M. L. Mathur, "A Text Book of Machine Drawing".*
8. *N. D. Bhatt, "Machine Drawing", Charotar.*
9. *Jolhe, "Machine Drawing", TMH.*

Magazine:
1. *International Metal Work News.*
2. *Industrial Laser Solution.*

Journals:
1. *Automation and Remote Control, Maik Nauka/ Inter periodical/ Springer.*
2. *Automatica, Pergamon, Elsevier.*
3. *Autonomous Robots, Springer.*

Name of the Module: Numerical Methods in Engineering
Module Code: MAS 602
Semester: 6th
Credit Value: 4 [P=2, T=0, L=3]
Module Leader:

A. Objectives:

The course is design to meet with the following objectives:
1. Introducing the basic concepts of round off error, truncation error, numerical stability and condition, Taylor polynomial approximations; to derive and apply some fundamental algorithms for solving scientific and engineering problems: roots of nonlinear equations, systems of linear equations, polynomial and spline interpolation, numerical differentiation and integration, numerical solution of ordinary differential equations.
2. Application of computer oriented numerical methods which has become an integral part of the life of all the modern engineers and scientists. The advent of powerful small computers and workstation tremendously increased the speed, power and flexibility of numerical computing.
3. Injecting future scope and the research directions in the field of numerical methods.

B. Learning outcomes:

Upon Completion of the subject, students will be able to:
1. Do Numerical Analysis, which is the study of algorithms for solving problems of continuous mathematics.
2. Know numerical methods, algorithms and their implementation in 'C' for solving scientific problems.
3. Substantially prepared to take up prospective research assignments.

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C. Subject Matter:

Unit I:

    Errors in computation: Overflow and underflow, Approximation in numerical computation, Truncation and round off errors, Propagation and control of round off errors, Chopping and rounding off errors, Pitfalls (hazards) in numerical computations (ill conditioned and well conditioned problems).

Unit II:

    Interpolation: Lagrange's Interpolation, Newton's forward & backward Interpolation Formula. Extrapolation, Newton's Divided Difference Formula, Error, Problems.

Unit III:

    Numerical Differentiation: Use of Newton's forward and backward interpolation formula only.

    Numerical Integration: Trapezoidal formula (composite), Simpson's 1/3rd formula (composite), Romberg Integration (statement only), Problems.

Unit IV:

    Numerical Solution of System of Linear Equations: Gauss elimination method; Matrix Inversion, Operations Count, LU Factorization Method (Crout's Method), Gauss-Jordan Method, Gauss-Seidel Method, Sufficient Condition of Convergence.

    Numerical Solution of Algebraic and Transcendental Equations: Iteration Methods, Bisection Method, Secant Method, Regula-Falsi Method, Newton-Raphson Method.

    Numerical solution of Initial Value Problems of First Order Ordinary Differential Equations: Taylor's Series Method, Euler's Method, Runge-Kutta Method (4th order), Modified Euler's Method and Adams-Moulton Method.

D. List of Practical: (Minimum six experiments are required to be performed)
1. Assignments on Interpolation: Newton forward & backward, Lagrange.
2. Assignments on Numerical Integration: Trapezoidal Rule, Simpson's 1/3rd Rule.
3. Assignments on Numerical solution of a system of Linear Equations: Gauss elimination, Gauss Jordan, Matrix Inversion, Gauss Seidel.
4. Assignments on Solution of Algebraic Equations: Bisection, Secant, Regula-Falsi, Newton-Raphson Methods.
5. Assignments on Ordinary Differential Equations: Taylor Series, Euler's Method, Runge-Kutta (4th Order).

E. Teaching/Learning/Practice Pattern:

    Teaching: 40%
    Learning: 10%
    Practice: 50%

(Teacher is to divide components for T/R/P)

F. Examination Pattern:
1. Theoretical Examination : Open book and on line.
2. Practical Examination: Conducting Experiments and Viva-Voce.

G. Reading list:

Books:
1. *D. Kincaid and W. Cheney, "Numerical Analysis: Mathematics of Scientific Computing", 3rd Ed., AMS, 2002.*
2. *K. E. Atkinson, "An Introduction to Numerical Analysis",2nd edition , Wiley, 1989.*

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3. S. D. Conte and C. de Boor, "Elementary Numerical Analysis - An Algorithmic Approach", 3rd edition ,McGraw-Hill, 1981.

4. C.M. Bender and S.A. Orszag, "Advanced Mathematical Methods for Scientists and Engineers",1st edition, McGraw-Hill Book Co., 1978.

5. John H. Mathews, "Numerical Methods for Mathematics Sciences and Engineering" 2nd ed. Prentice Hall of India, New Delhi 2003.

6. M. K. Jain, S.R.K. Iyengar and R.K. Jain, "Numerical method for Scientific and Engineering Computation", New Age International Pvt. Ltd. 3rd edition, 1993,

7. V. Rajaraman," Computer Oriented Numerical Methods, Pearson Education" 3rd edition , 2013

8. Steven C. Chapra, "Numerical Methods for Engineers", 4th Ed., McGraw Hill, 2002.

9. Brian Bradie, "A Friendly Introduction to Numerical Analysis",1st edition Pearson Prentice Hall, 2006.

10. Günther Hämmerlin and Karl-Heinz Hoffmann, "Numerical Mathematics",1st edition, Springer-Verlag, 1991.

Magazines:
1. Current Science (Indian Academy of Sciences).
2. The Mathematics Student (Math Student) (Indian Mathematical Society).
3. Mathematical Spectrum (The University of Sheffield).
4. Mathematics Magazine (Mathematical Association of America).
5. Plus magazine (University of Cambridge).
6. Ganithavahini (Ramanujan Mathematical Society).

Journals:
1. Numerische Mathematik, Springer Link.
2. Acta Numerica, Cambridge University Press.
3. SIAM Review, University of Bristol, UK.
4. Journal of Computational Physics, Elsevier.
5. SIAM Journal on Numerical Analysis, University of Bristol, UK.
6. SIAM Journal on Scientific Computing, University of Bristol, UK.
7. IMA Journal of Numerical Analysis, Oxford Journals.
8. Mathematics of Computation, American Mathematical Society.
9. Foundations of Computational Mathematics, Springer Link.

Name of the Module: Engineering Ethics & IPR
Module Code: HSS 601
Semester: 6th
Credit Value: 3 [P=0, T=0, L=3]
Module Leader:

A. Objectives:

The course is design to meet with the following objectives:
1. Imparting theoretical lectures with case discussion.
2. Providing teaching with inclusive learning.
3. Making students aware about the importance of this subject in their future

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B. Learning outcomes:

Upon completion of the subject, students will be able to:

1. Work with efficiency as they had knowledge of the subject.
2. Perform much better in their workplace.

C Subject Matter:

Unit I:

Engineering as a profession: Historical and social context, Ethics in Engineering, Codes of Engineering Ethics, history and purpose, consequentialism and utilitarianism, Deontological approaches, duties, rights and respect for a person, responsibility, virtue Ethics, honesty, moral autonomy, obligations of Engineering profession and moral propriety.

Unit II:

Engineer's moral responsibility: Safety and human right, risk assessment and communication, product liability, development ethics, engineers and employer relationship, whistle blowing and its moral justifications.

Unit III:

Computer Ethics: Social impact of computers, Computer and gender issues, privacy, cyber crime, ethical use of software's, intrinsic value of nature.

Unit IV:

IPR I: Intellectual property, definition, types, rights and functions, patents, trademark, software design, industrial designs, semi-conductor and integrated circuits layout design, grant of patent in India, authority and procedure, patent forms, surrender and revocation of patents and compulsory licensing, acquision of inventions by the Government.

IPR II: Contents of draft application for patents, Drafting patent specification and claims, WTO and drafting patent specification and claims, IPR infringement and piracy under Indian Laws.

D. Teaching/ Learning:

Teaching: 50%
Learning/ case presentation: 30%
Assignment: 10%
Attendance: 10%

E. Examination pattern:

1. Theoretical Examination: 50
2. Class test: 30
3. Assignment: 20

F. Reading list:

Books:

1. *S. Chowdhury, "Blending the best of the East & West" , 1st edition ,EXCEL*
2. *V. Ghosh, "Ethics and Mgmt. & Indian Ethos". 2nd edition vikash publishing house*
3. *Pherwani, "Business Ethics", EPH.*
4. *Balachandran Raja,Nair, "Ethics, Indian Ethos and Mgmt.",2nd edition , Shroff Publishers.*
5. *Velasquez, "Business Ethics: concept and cases",7th edition, Pearson.*

Magazine:

1. Industry Week.

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Journals:

1. *Journal of Business Ethics.*
2. *The Journal of Ethics.*
3. *Ethics, University of Chicago Press.*
4. *Kennedy Institute of Ethics Journal.*
5. *Journal of Global Ethics.*

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Name of the Module: Disaster Management
Module Code: HSS 602
Semester: 6th
Credit Value: 2 [P=0, T=0, L=2]
Module Leader:

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A. Objectives:
The course is design to meet with the following objectives:
1. Imparting theoretical lectures with case discussion.
2. Providing teaching with inclusive learning.
3. Making students aware about the importance of this subject in the future prospect.

B. Learning outcomes:
Upon completion of the subject, students will be able to:
1. Work with efficiency as they had knowledge of the subject.
2. Perform much better in their workplace.

C. Subject Matter:
 Unit I:
  Introduction: Disaster preparedness, Goals and objectives of ISDR Programme, Risk identification, Risk sharing.
  Disaster and Development: Development plans and disaster management, Alternative to dominant approach, disaster-development linkages, Principle of risk partnership.
Unit II:
  Disaster Management and Risk Reduction in Garment Industry: Types of disasters and disaster plans, Processing machines and utilities, Sustainable livelihoods and their Protection, Recovery from disaster, fire, boiler mishap, Garment Industry health monitoring and Disaster aids.
Unit III:
  Awareness of Risk Reduction: Trigger mechanism, constitution of trigger mechanism, risk reduction by education, disaster information network and risk reduction by public awareness.
Unit IV:
  Development Planning on Disaster: Implication of development planning, financial arrangements, areas of improvement, disaster preparedness and community based disaster management, emergency response.
  Seismicity: Seismic waves, Earthquakes and faults, measures of an earthquake, magnitude and intensity ground damage, Tsunamis and earthquakes.

D. Teaching/ Learning/Practice Pattern:

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Teaching	: 50%
Learning/ case presentation	: 30%
Assignment	: 10%
Attendance	: 10%

E. Examination pattern:

1. Theoretical Examination : 50
2. Class test : 30
3. Assignment : 20

G. Reading List:

Books:

1. Pardeep Sahni, Madhavi Malalgoda and Aariyabandu, "Disaster risk reduction in south Asia", 1st edition, PHI, 2009
2. Amita Sinvhal, "Understanding Earthquake Disasters", 1st edition ,TMH, 2010.
3. MHA, GOI-UNDP, "Disaster Management in India", 2009
4. NDMA, "Incident Response Guidelines", 2009
5. "Disaster Management Act", 2005.

Magazines:

1. Crises and Disaster Management Magazine.
2. Emergency Management.

Journals:

1. Asian Journal of Environment and Disaster Management.
2. International Journal of Disaster Management.
3. IDRIM Journal.
4. Journal of Disaster Risk Studies.
5. Emergency Management Review.

Semester- VII

Name of the Module: Mass Communication for Technology
Module Code: HSS 701
Semester: 7th
Credit Value: 3[P=0, T=0, L-3]

A. Objectives:

The course is design to meet with the following objectives:

1. Imparting theoretical lectures with case discussion.
2. Teaching with inclusive learning.
3. Making students aware about the importance of this subject in their future career.

B. Learning Outcomes:

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Upon completion of the subject, students will be able to:

1. Work with efficiency as they had knowledge of the subject.
2. Perform much better in their workplace.

C. Subject Matter:

Unit I:

Fundamentals of Mass Communication: Definition of Mass Communication, importance, scope, importance, related fields, history of mass communication.

Unit II:

Dissemination of Scientific & Technical Knowledge (DSTK): Difficulties with distribution of scientific and technical information is rapid increasing with unprecedented spade of science and technology. Further, engineers are made to meet with this challenge. The subject should cover the knowledge so as to establish adequate and effective distribution of information. Lack of information cannot make a sound engineer. Engineers should be specialists in information dissemination for which a course on DSTK is of paramount importance. Engineers should be made to write articles and research papers fluently and confidently. They should be taught to organize seminar and conferences deliver talks as well in the seminars and conferences. They should also be taught the technique of publishing magazines and journals.

D. Teaching/ Learning/ Practice Pattern:

Teaching	: 50%
Learning/ case presentation	: 30%
Assignment	: 10%
Attendance	: 10%

E. Examination pattern:

1.	Theoretical Examination	: 50
2.	Class test	: 30
3.	Assignment	: 20

F. Reading List:

Books:

1. *D. V. R. Murthy, Development of Journalism, Dominant Publishers, 2001.1st publication*
2. *U. Naarula, Development Communication Theory and Practice, Har-Anand Publication Ltd New Delhi; 1990.*
3. *S. C. Sharma, Media Communication and Development, Rawat Publication, 1987.*
4. *UNESCO, 'Different Theories and Practice', 1982.*

Magazines:

1. *Media and Communication.*
2. *Communication Magazine.*

Journals:

1. *Mass Review.*
2. *Journal of Communication Studies.*
3. *Mass Communication and Society.*
4. *Journal of Mass Communication.*

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Department of Mechanical Engineering

5. *Communicator.*
6. *Journal of Communication.*

Name of the Module: Research Paper Communication
Module Code: HSS 702
Semester: 7th
Credit Value: 1[P=2, T=0, L=0]

 A. Objectives: The course is designed to meet the objectives of:
1. Business research is a process of planning, acquiring, analyzing and disseminating relevant data, information and insights to decision makers in ways that mobilize the organization to take appropriate actions that, in turn, maximize business performance.
2. Making students aware about the importance of this subject in their future career.

B. Learning outcomes: Students successfully completing this module will be able to :
1. Understanding of Research process and types
2. Formulate the research problem
3. Design the research
4. Able to collect data
5. Analyze the data using SPSS
6. Interpret the results
7. Write the report

C. Subject matter:
Unit 1: Introduction to Business Research-Meaning and Significance of Research in Business; Different Approaches to Research – Scientific Methods and Non-scientific Methods; **Data Collection in Classroom**: Principles and purposes, description, strengths and limitations, where and how to begin data collection, designing suitable instruments, recording data, data maintenance.
Unit II: The Research Problem and Design-Formulation and Definition of Business Research Problem; Formulation of Research Hypotheses, Business Research Design – Meaning and Formulation **Unit III: Sampling Design and Measurement Techniques-** The Sampling Design Process; Types of Sample Design –Probability and Non-probability Sampling Designs.
Unit IV: Data Collection Tools and Data Processing-Questionnaires and Observation Forms; Questionnaire Design Process;
Unit V: Analysis of Data- Basic Data Analysis – Descriptive Statistics; Univariate Statistics – Hypotheses Testing; Bivariate Analysis – Test of Differences and Measures of Association; Multivariate Analysis.
Unit VI: Business Research Report-Importance of the Report & Presentation; Business Report Format; Report Writing; Oral Presentation; Research Follow-up

D. Teaching/ Learning/ Practice Pattern:
1. Teaching : 50%
2. Learning/ case presentation : 30%
3. Assignment : 10%
4. Attendance : 10%

E. Examination pattern:

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1. Theoretical Examination : 50
2. Class test : 30
3. Assignment : 20

F. Reading lists: Books:

1. Zikmund, Babin, Carr & Griffin. Business Research Methods, Cengage Learning. 8th Edition.

2. Bryman & Bell. Business Research Methods, Oxford. 3rd Edition.

3. Cooper & Schindler. Business Research Methods, TMH

4. C.R. Kothari, Research Methodology: Methods and Techniques,New Age International,

Magazines:

1. R & D Magazine

2. Research Magazine

3. Scientific Magazine

Journals:

1. Mass Review

2. Journal of Communication Studies

3. Mass Communication and Society

4. Journal of Mass Communication

5. Communicator

6. Journal of Communication

Name of the Module: Refrigeration and Air-Conditioning
Module Code: ME 701
Semester: 7th
Credit Value: 5[P=3, T=0, L=3]
Module Leader:

A. Objectives:

The course is designed to meet the following objectives:

1. Learning the fundamental principles and different methods of refrigeration and air conditioning.
2. Study of various refrigeration cycles and evaluate performance using p-h charts and/ or refrigerant property tables.
3. Understand the basic air conditioning processes on psychometric charts, calculate cooling load for its applications in comfort and industrial air conditioning.
4. Study of the various equipment-operating principles, operating and safety controls employed in refrigeration air conditioning systems.

B. Learning Outcome:

Upon completion of the subject, students will be able to:

1. Define the fundamental principles and applications of refrigeration and air conditioning system.
2. Explain the properties, applications and environmental issues of different refrigerants.
3. Calculate cooling capacity and coefficient of performance of air refrigeration system, VCRS and VARS.

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4. Use P-h, T-S and Psychrometric charts to solve refrigeration and Air conditioning design problems.

C. Subject Matter:

Unit I:

Principles of Refrigeration & Refrigeration Cycle: Reversed Carnot Cycle, Steam Jet Refrigeration System, Refrigerants, Designation and trade name, Physical, Chemical &Thermodynamic properties of principal refrigerants, Vapour Compression Refrigeration Cycle, Deviation from actual cycle, Air Refrigeration Systems, Bell-Coleman Cycle, evaporation & bootstrap evaporation type, T-s & P-h diagrams, COP.

Unit II:

Absorption System of Refrigeration: Electrolux Refrigerator, Refrigeration Equipments-Types of Compressors, Condensers & Evaporators, Flash chamber multi compressor, multi evaporator, production of load, temperature, Electric control, Surface requirements for evaporators & condensers, refrigeration piping, materials, moisture removal.

Refrigeration Controls: liquid refrigerant control automatic & thermostatic expansion valves, float valves, section line controls.

Applications of Refrigeration: ice making, food preservation, household refrigerators, cold storage.

Psychometrics: Atmospheric air, air and humidity, terms and calculation, psychrometric chart, air humidity processes, humidification &dehumidification, By-pass factor, summer and winter air load, housing system.

Unit III:

Comfort Air conditioning: effective temperature, comfort chart, ventilation requirements.

Solar Radiation: Distribution of solar radiation, direct and diffuse radiation, earth sun angles and their relationships, direct solar radiation on a vertical, horizontal, inclined surface, heat gain through glass, effect of shading devices, heat transfer in building structures through walls and roofs, Empirical methods to evaluate heat transfer through walls and roofs, infiltration, passive heating and cooling of building, Air distribution system, basic theory, air duct losses, design of air duct system, air delivery and distribution.

Unit IV:

Air conditioning systems: unit conditioners, central air conditioning, control of air conditioning apparatus, space cooling load calculation, heat transmission through barriers, solar radiation, infiltration, occupants, electric lights &appliances, product load, outside air and ventilation, SHR By-pass factor, ADP, refrigeration load, Fluid flow and pressure loss, equivalent length system & duct design, air distribution system, basic control system, Solar heating and cooling, air conditioning through solar system, building designs for air conditioning.

D. List of Practical:

1. Study of domestic refrigerator, water cooler, Window air conditioners, split units etc.
2. To perform electrical practices like wiring, soldering.
3. To perform practices on evacuation and dehydration, leak detection, charging, etc.
4. To repair or perform servicing of condensers and evaporators.
5. Study of pressure drops in ducts.
6. To repair hermetically sealed units.
7. To perform complete servicing of a refrigerator.
8. To perform complete servicing of an air conditioner.
9. To determine Fault detection.
10. To adjust the automatic system.
11. To make wiring diagrams of an air conditioner and central plants.
12. To test safety and operating controls such as relay, thermostat, HP and LP Cut out, over load protector, solenoid valve, oil pressure, Failure control etc.
13. To carry out electric wiring of refrigerator bottle cooler.

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14. To carry out electric wiring of window type air conditioner.

E. Teaching/Learning/Practice Pattern:

Teaching: 50%
Learning: 30 %
Practice: 20 %

(Teacher is to divide components for T/R/P)

F. Examination Pattern:
1. Theoretical Examination and Open book examination.
2. Practical Examination.

G. Reading List:
Books:
1. *C. P. Arora, "Refrigeration and Air Conditioning", TMGH.3rd edition*
2. *W. F. Stoecker and J. W. Jones, "Refrigeration and Air Conditioning", MGH.*
3. *Dosat, "Basic refrigeration", MGH.*
4. *Prasad, "Refrigeration and air conditioning", MGH., 2nd edition*

Magazine:
1. *Process Cooling.*

Journals:
1. *International Journal of Refrigeration, Elsevier.*
2. *Refrigeration and Air Conditioning Manufacturers Association, RAMA.*
3. *International Journal of Air-Conditioning and Refrigeration, World scientific.*

Name of the Module: Creative Design
Module Code: ME 702
Semester: 7th
Credit Value: 2[P=0, L=2, T=0]
Module Leader:

A. Objectives:
The course is design to meet with the following objectives:
1. To learn basic Concept Mechanical systems design.
2. To learn basic consideration of safety factor in designing.
3. To learn design optimization with respect to efficient material and performance.

B. Learning Outcome:
Upon completion of the subject, students will be able to:
1. Understand safety factor in designing.
2. Optimize design for efficient performance.

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C. Subject Matter:

Unit I:
   Introduction to Design: Design, Design Process, Creative Design, Concept of Mechanical System Design.

Unit II:
   Creative Problem Solving Techniques: Creative Process, Creativity Characteristics, Analysis of existing Design, Mathematical & Experimental Analysis.

Unit III:
   Creative Design Methodology: Introduction, generalization, specialization, particulization, Atlas of new Design.

Unit IV:
   Fine arts: Introduction, Free Hand sketching, Computer graphics, 3D modelling.

D. Teaching/Learning/Practice Pattern:

   Teaching: 50 %
   Learning: 50 %
   Practice: 0%

(Teacher is to divide components for T/R/P)

E. Examination Pattern:
   1. Theoretical Examination and Open book examination.

G. Reading List:
Books:
   1. Simant, Mishra, Ramesh Chandra, "Mechanical System Design", PHI.
   2. Farazdak Haideri, "Mechanical System Design", Nirali Prakashan.
   3. S. P. Patil , "Mechanical System Design", Jaico Publishing House,
   4. J. E. Shigley, " Mechanical Engineering Design", McGraw-Hill. 2nd edition
   5. Hong-sen-yan, "Creative Design of Mechanical Devices", Springer,1st edition

Magazine:
   1. ES Engineering System.
   2. Gear Solution.
   3. Machine Design.

Journals:
   1. Journal of Mechanical Design, ASME.
   2. Journal of Advanced Mechanical Design, Systems, and Manufacturing, JSME.
   3. Journal of Advanced Mechanical Design, Systems, and Manufacturing, J-stage.

Name of the Module: Green Car Technology
Module Code: ME 705
Semester: 7th
Credit Value: 3 [P=2, T=0, L=2]
Module Leader:

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A. Objectives:

The course is design to meet with the following objectives:

1. Improve efficiency of automobiles.
2. Increase the security of automobiles.
3. To ensure increased safety of automobiles.
4. To increase the performance of automobiles using electronics and electrical technology.

B. Learning Outcomes:

Upon completion of the subject, students will be able to:

1. Describe construction, functions and applications of various sensors and actuators used in modern vehicle.
2. Explain modern Ignition systems of S.I. and C.I. Engines.
3. Explain latest advancement in Engine technology.
4. Identify and describe various advanced peripheral system used in automobile.
5. Demonstrate various safety features and equipment used in modern vehicle.
6. Identify various modern features for better functioning of vehicle.

C. Subject Matter:

Unit I:

   Introduction: Fundamentals of Green Technology, Need of Green Technology, Existing car technology, Biodiversity, Green Car Technology, Renewable source of energy, Alternative fuels.

Unit II:

   Advanced Ignition System: Electrical & Electronics Ignition systems, Modern Spark Ignition System (DTSI, TDSI, Multi electrode etc system) Insulated Coils, Non-Battery Energy Storage-Ultra Capacitors and flywheels.

Unit III:

   Advancement in Engine & related components: Introduction & types of hybrid car, Hybrid drive system, Solar cars, compressed air car, Basic components of Blue Motion Technology (DGG, TSI, TDI, GDI variable value timing system).

D. List of Practical:

   1. Seminar on Industrial visit (Automobile Industry).

E. Teaching/ Learning/ Practice Pattern:

   Teaching: 40%
   Learning: 30%
   Practice: 30%

F. Examination Pattern:

   1. Theoretical Examination/ Open Book.
   2. Practical Examination.

G. Reading List:

Books:

   1. *Leitman, Seth and Brant, Bob, "Build Your Own Electric Vehicle", 2nd Edition. McGraw-Hill.*
   2. *Tobin Smith, Jim Woods, Liz Claman (2008). Billion Dollar Green, "Waving the Green Flag, Clean Transportation", John Wiley and Sons.*

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3. *Fabio Orecchini, Adriano Santiangeli , "Lithium-Ion Batteries", Alessandro Dell'Era.*
4. *T.Hofman, "Alternative Fuels and Advanced Vehicle Technologies for Improved Environmental Performance" Woodhead Publishing.*
5. *S. Carroll, C. Walsh, C. Bingham, R. Chen, M. Lintern "Sustainable Vehicle Technologies", Woodhead Publishing.*

Magazines:
1. *Automobiles.*
2. *Top Gear.*
3. *Motor Trend.*
4. *Car and Driver.*

Journals:
1. *CIRP Journal of Manufacturing Science and Technology.*
2. *Journal of Power Sources.*
3. *Journal of Cleaner Production.*

List of Electives

ELECTIVE – I

Name of the Module: Combustion Engineering
Module Code: ME 703/1
Semester: 7th
Credit Value: 3[P=0, T=0, L=3]
Module Leader:

A. Objectives:

The course is design to meet with the following objectives:
1. To prepare the student for engineering analysis and design of combustion systems.
2. Assessment of fire and explosion hazards, based on fundamental physical and chemical science of combustion phenomena.

B. Learning Outcome:

Upon completion of the subject, students will be able to:

1. Understand physical and chemical features of simple flames and combustion processes.
2. Describe the major features of premixed combustion, detonation and deflagration modes, laminar and turbulent premixed flames.

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3. Calculate product composition, and estimate the adiabatic flame temperature and equilibrium composition of major combustion products.
4. Analyze pollutants generated in typical combustion processes and the available control techniques.

C. Subject Matter:

Unit I:

 Energy sources: Energy scenario, review of general fuel properties & their resources in Indian context, solid, liquid & gaseous fuels.

Unit II:

 Various refining methods of Fossil fuels and Nuclear fuels: Synthetic and other fuels, hydrocarbon fuel testing, Bio fuels, Fuel cells, Fuel preparation for combustion.

Unit III:

 Theories of combustion: Burners & Combustors for solid, liquid & gaseous fuels, Fuel chemistry, Thermodynamics of combustion, calculation of temperature and equilibrium flame gas composition for constant pressure and constant volume combustion.

Unit IV:

Premixed flames, theories of flame propagation, factors affecting propagation velocity, effects of turbulence, Diffusion flames, burning rates of solid and liquid fuels, combustion of liquid, droplet and fuel sprays, Combustion of coal and pulverized particles in air, Combustion in engines, Gas turbine combustion system, Stoichiometric & combustion reactions, Flue gas analysis.

D. Learning/Practice Pattern:

 Teaching: 70 %

 Learning: 30 %

 Practice: 0 %

E. Examination Pattern:

 1. Theoretical Examination.

F. Reading List:

Books:

1. *S. P. Sharma & C. Mohan, "Fuels and combustions", TMGH.*
2. *A. M. Kanury, "Introduction to combustion phenomena", Gordon & Beach Science Publication.*
3. *W. Francis, "Fuels and fuel technology (Vol. I & II"), 3rd edition PHI.*
4. *J. S. S. Brame & J.G. King, "Fuels-Solid, Liquid & Gaseous", MGH.*
5. *S. R. Turns, "Combustion", MGH.*

Magazine:

1. *Model Engine Builder.*
2. *Car and Driver.*
3. *Engine Technology International.*
4. *ES Engineered Systems.*

Journals:

1. *Journal of Mechanical Engineering, Editorial Office Of Chinese Journal Of Mechanical Engineering.*

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2. *Journal of Applied Fire Science, Baywood Publishing Co. Inc.*
3. *Combustion and Flame, Elsevier.*

Name of the Module: Computational Fluid Dynamics
Module Code: ME 703/2
Semester: 7th
Credit Value: 3[P=0, T=0, L=3]
Module Leader:

A. Objectives:

The course is design to meet with the following objectives:

1. Equip students with the knowledge base essential for application of computational fluid dynamics to engineering flow problems
2. Provide the essential numerical background for solving the partial differential equations governing the fluid flow

B. Learning Outcome:

Upon completion of the subject, students will be able to:

1. Understand solution of aerodynamic flows. Appraise & compare current CFD software
2. Define and setup flow problem properly within CFD context, performing solid modelling using CAD package and producing grids via meshing tool.
3. Solve Navier-Stokes equations with proper boundary condition.
4. Use CFD software to model relevant engineering flow problems. Analyse the CFD results. Compare with available data, and discuss the findings.

C. Subject Matter:

Unit I:

Introduction: CFD as a design and research tool, Applications and impact of CFD; Concepts of finite control volume & infinitesimal fluid elements, analysis with fixed and moving fluid elements, Substantial derivative, Divergence of velocity – its physical significance,

Unit II:

Governing Equations: Derivation of Continuity equations for different flow models, conversion from one form of continuity equation to other forms, Differential form Vs. integral form, Momentum equation, Energy equation, Forms of equations for viscous and inviscid flows, Boundary conditions, Conservation and non conservation forms, Forms of equations suited for CFD, Shock fitting and shock capturing

Partial Differential Equations And Descretisation: Classification of PDEs, method of determining the type of PDEs, General behavior of PDEs, Hyperbolic, Parabolic and Elliptic equations, Well posed and Ill posed problems; Finite difference techniques, Difference equation, Explicit and Implicit Approaches, Errors in difference equations, Stability analysis.

Unit III:

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Introduction to Grid Generation: Transformations of equations, Metrics and Jacobians, Transformed versions of governing equations, Stretched grid and Boundary fitted coordinate system

Simple CFD Techniques: Crank-Nicolson scheme, Dufort-Frankel scheme, Lax-Wendroff and Mac Cormack techniques, Viscous flows, Conservation form and space marching, Relaxation technique, artificial viscosity, application in inviscid flows, Vorticity transport method; ADI (Alternating Direction Implicit) technique, Pressure correction technique, SIMPLE algorithm; Programming in FORTRAN/ C/ C++

Unit IV:

Applications: Finite difference method to solve WAVE equation, HEAT equation, POISSON & LAPLACE equations, BURGER equation. Numerical methods applied to nozzle flow, Coutte Flow; Prandtl-Meyer flow and supersonic flow over flat plates; Programming in FORTRAN/ C/ C++; CFD Softwares.

D. Teaching/Learning/Practice Pattern:

Teaching: 70 %

Learning: 30 %

Practice: 0 %

(Teacher is to divide components for T/R/P)

E. Examination Pattern:

1. Theoretical Examination

F. Reading List:
Books:

1. *J. D. Anderson, Jr., "Computational Fluid Dynamics", MGH*
2. *D.A. Anderson, J.C. Tannehill & R.H. Pletcher, "Computational Fluid Mechanics & Heat Transfer", 2nd edition MGH*
3. *S. V. Patankar, "Computational Fluid Mechanics and Heat Transfer", Hemisphere.*
4. *Anit W. Date, "Introduction to Computational Fluid Dynamics", Cambridge University Press*
5. *C. A. Fletcher, "Computational Techniques for Fluid Dynamics, Vol. I & II" , Springer Verlag, Berlin*

Magazine:
1. The CFD Magazine.

Journals:
1. *Engineering Applications of* Computational Fluid Mechanics.
2. *International Journal of Computational Fluid Dynamics, Taylor & Francis.*
3. *Journal of Mechanical Engineering, Editorial Office of Chinese Journal of Mechanical Engineering.*
4. *Fluid Dynamics And Materials Processing, Tech Science Press.*

Name of the Module: Aerodynamics
Module Code: ME 703/3

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Semester: 7th

Credit Value: 3[P=0, T=0, L=3]

Module Leader:

A. Objectives:

The course is design to meet with the following objectives:

1. Formulate and apply appropriate aerodynamic models to predict the forces on and performance of realistic three-dimensional configurations.

2. Assess the applicability of aerodynamic models to predict the forces on and performance of realistic three-dimensional configurations and estimate the errors resulting from their application.

B. Learning Outcome:

Upon completion of the subject, students will be able to:

1. Define aerodynamic devices on an aircraft.
2. Analyse (using both mathematical analysis and numerical analysis) the aerodynamic behaviour of finite wings.
3. Calculate aerodynamic forces acting on an aircraft.
4. Explain the changes in the characteristics of compressible and incompressible flows through variable-area sections using mathematical relations.

C. Subject Matter:

Unit I:

Introduction: Governing equations, potential flows, Kulta-Joukowski's theorem, flow over arbitrary bodies. Incompressible flow over aerofoils: Aerofoil nomenclature and characteristics, Thin Aerofoil theorem- Kutta condition, Kelvin's circulation theorem

Unit II:

Vortex panel model: effect of camber and thickness; Estimation of Aerodynamic forces and moments from pressure distribution.

Unit III:

Incompressible flow over finite wings: Down wash and induced drag, Biot-Savart law and Helmholtz's Vortex theorem. Prandtle's classical lifting line model, lifting surface theory.

Unit IV:

Trailing edge boundary condition: Prandtle-Gluert's theory, Supersonics aerofoils, Ackert's theorem, Wave drag, Area rule, conical flow, Axisymmetric flow, Introduction to stability Control of aircraft.

Numerical Vortex Lattice method, Compressible flow over aerofoils, Wave patterns, Oblique shock, and expansion waves.

D. Teaching/Learning/Practice Pattern:

   Teaching: 70 %

   Learning: 30 %

   Practice: 0 %

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E. Examination Pattern:

1. Theoretical Examination.

F. Reading List:

Books:
1. *J. D. Anderson Jr., "Fundamentals of Aerodynamics", MGH*
2. *J. J. Bertin and M. L. Smith, " Aerodynamics for engineers",2nd edition , MGH*
3. *L. J. Clancy, "Aerodynamics", Himalayan Books*
4. *A. M. Kuethe and C. Y. Chow, "Foundations of Aerodynamics", 5th edition , Wiley*
5. *W. F. Durrand, "Aerodynamics theory", PHI*

Magazine:
1. *Pedal Power, University of Maryland.*
2. *The Power of 25.*
3. *Batplane.*

Journals:
1. *International Journal of Aerodynamics.*
2. *Journal of Wind Engineering & Industrial Aerodynamics, Elsevier.*
3. *Journal of Mechanical Engineering, Editorial Office of Chinese Journal of Mechanical Engineering*
4. *Journal of Aeronautics Astronautics and Aviation, the Aeronautical and Astronautical Society of the Republic of China.*
5. *Journal of Aerospace Engineering, American Society of Civil Engineers, ASCE.*
6. *Journal of Aircraft, American Institute of Aeronautics and Astronautics Inc. AIAA.*

Name of the Module: High Pressure Equipment Design
Module Code: ME 703/4
Semester: 7th
Credit Value: 3[P=0, T=0, L=3]
Module Leader:

A. Objectives:
The course is design to meet with the following objectives:
1. To be able to apply the requirements of the relevant industry standards to the mechanical design of equipments used in the process industry and above ground atmospheric storage.
2. To specify appropriate physical property models to simulate processes.

B. Learning Outcome:
Upon completion of the subject, students will be able to:

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1. Identify the elements of the design process.
2. Identify and evaluate the stresses acting based on different theory of failures.
3. Calculate stresses and loads involved with variable loading including fatigue effect.
4. Understand design principles of high pressure equipments
5. Devise a list of concepts for a design application using idea-generation techniques.

C. Subject Matter:

Unit I:

Design Considerations: Preliminary considerations, Design construction and features, Stress analysis of components shells. Thick and thin shells.

Unit II:

Ends, flanges, local attachments, etc.

Unit III:

Material selection, Special type of vessels-high pressure applications.

Unit IV:

Externally loaded vessels, etc. Design system, Use of Codes.

D. Teaching/Learning/Practice Pattern:

Teaching: 70 %

Learning: 30 %

Practice: 0 %

(Teacher is to divide components for T/R/P)

E. Examination Pattern:

1. Theoretical Examination

F. Reading List:

Books:

1. *Van Nostand, Pressure vessel Design, MGH.*
2. *M. V. Joshi, Process equipment design,3rd edition , McMillan India.*
3. *Material Handling equipment Hand book, MGH.*

Magazine:

1. *Wireless Design & Development.*
2. *Product Design & Development magazine.*
3. *Vision Systems Design.*

Journals:

1. *Journal of Mechanical Engineering, Editorial Office of Chinese Journal of Mechanical Engineering.*
2. *International Journal for Engineering Modelling, University of Split.*
3. *Advances in Modelling and Analysis A, ASME.*
4. *Advances in Modelling and Analysis B, ASME.*
5. *Journal of Ergonomics*

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Department of Mechanical Engineering

6. *An International Journal for Fusion Energy and Technology devoted to Experiments, Theory, Methods and Design*
7. *Journal of Engineering, Design and Technology*
8. *Journal of Mechanical Design*

Name of the Module: Two Phase Flow and Heat Transfer

Module Code: ME 703/5

Semester: 7th

Credit Value: 3 [P=0, T=0, L=3]

Module Leader:

A. Objectives:

The course is design to meet with the following objectives:

1. To provide a rudimentary exposure to the thermo-fluid transport phenomena in one of the simplest multiphase systems: two-phase.
2. To formulate and solve problems associated with two-phase flow phenomena.
3. Design heat transfer equipment in which phase change (boiling or condensation) takes place.

B. Learning Outcome:

Upon completion of the subject, students will be able to:

1. Describe the most important phenomena and principles of two-phase flow in engineering applications.
2. Describe the concept boiling crisis (e.g., DNB - departure from nucleate boiling, and dryout) and its modelling.
3. Explain the main points of boiling and condensation, heat transfer, and their enhancement methods.
4. Apply the basic two-phase models and flow pattern maps to calculate the pressure drops of two-phase flow at various conditions.
5. Apply the models of critical flow and flooding to analyze limiting flow of engineering processes.

C. Subject Matter:

Unit I:

Introduction: Definitions, Properties of mixtures, Review of one-dimension conservation equations in single phase flows, Governing equations for homogeneous, separated and drift- flux, models.

Unit II:

Flow pattern and material handling: Flow pattern maps for horizontal and vertical system, Material handling: solid-liquid and solid-gas system, Particle distribution, Pressure variation, Simplified treatment of stratified, bubbly, slug and annular flows.

Thermodynamics of boiling: Pool boiling- onset of nucleation, heat transfer coefficient, Critical heat flux, effect of sub-cooling, flow boiling onset of nucleation, heat transfer coefficients.

Unit III:

Condensation: Film and drop wise condensation.

Unit IV:

Fluidized bed heat transfer

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D. Teaching/Learning/Practice Pattern:

Teaching: 70 %

Learning: 30 %

Practice: 0 %

(Teacher is to divide components for T/R/P)

E. Examination Pattern:

1. Theoretical Examination

F. Reading List:

Books:
1. *G. B. Wallis, One dimensional two phase flow, MGH.*
2. *J. B. Colier & J. R. Thorne, Convective boiling & condensation, 2nd edition , Oxford Science.*

Magazine:
1. *Two Phase Flow and Heat Transfer characteristics of a separate-type Heat Pipe, Tang, ZhiweiLiu, AijieJiang, Zhangyan.*
2. *LMS Imagine. Lab Two-Phase Flow Systems.*

Journals:
1. *Journal of Mechanical Engineering, Editorial Office of Chinese Journal of Mechanical Engineering.*
2. *International Communications in Heat and Mass Transfer, Elsevier Ltd.*

Name of the Module: Management of Production System

Module Code: ME 703/6

Semester: 7th

Credit Value: 3[P=0, T=0, L=3]

Module Leader:

A. Objectives:

The course is design to meet with the following objectives:

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

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B. Learning Outcome:

Upon completion of the subject, students will be able to:

1. Design and conduct experiments, as well as to analyse and interpret data.
2. Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
3. Function on multi-disciplinary teams and understand the professional and ethical responsibility.
4. Identify, formulate, and solve engineering problems.
5. Use the techniques, skills, and modern engineering tools necessary for engineering practice.

C. Subject Matter:

Unit I:

Types of Production: Job, Batch, Mass, Cellular production systems, automation in production systems, MTL and its mathematical models, material handling.

Unit II:

AGVS, TTW, Productivity Engineering: methods of improvement, cost analysis, marketing and sales, Inventory, production planning and control, Automated layout and flow analysis, systems concepts in production systems CAD, CIM.

Unit III:

Shop floor management techniques: Job card design, work centres, work study, time study applications.

Unit IV:

Quality circles, productivity quality teams: work force planning, TQM, ISO 9000, Future factories and MAP, Group technology and FMS.

D. Teaching/Learning/Practice Pattern:

Teaching: 70 %
Learning: 30 %
Practice: 0 %

(Teacher is to divide components for T/R/P)

E. Examination Pattern:

1. Theoretical Examination

F. Reading List:

Books:

1. Martinch, "Production and Operations Management",1st edition Wiley Eastern Ltd.
2. Ralph M. Barnes, "Production and Operations Management", Wiley Eastern Ltd.
3. E. S. Buffa, "Modern production and operation management", 8th edition ,Wiley Eastern Ltd.

Magazine:

1. Journal of Operations Management.
2. International Journal of Operations and Production Management.
3. Operations Management Research.

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4. *Production and Operations Management.*

Journals:
1. *Journal of Mechanical Engineering, Editorial Office of Chinese Journal of Mechanical Engineering.*
2. *Production Engineering, Springer Verlag.*
3. *Production Planning and Control, Taylor and Francis Ltd.*
4. *Process Safety Progress, John Wiley and Sons Inc.*

Elective II

Name of the Module: Composite Materials
Module Code: ME 704/1
Semester: 7th
Credit Value: 3[P=0, T=0, L=3]
Module Leader:

A. Objectives:
The course is design to meet with the following objectives:
1. To teach students the basic concepts involved in fiber reinforced composites and their applications in engineering.
2. The objective for this course is to develop an understanding of the linear elastic analysis of composite materials. This understanding will include concepts such as anisotropic material behaviour and the analysis of laminated plates. The students will undertake a design project involving application of fibre reinforced laminates.

B. Learning Outcome:
Upon completion of the subject, students will be able to:
1. Understand the concept of various composite materials.
2. Evaluate mechanical properties of composite materials.
3. Explain different manufacturing techniques for composites.
4. Analyze fiber-reinforced composites for mechanical properties

C. Subject Matter:
Unit I:
> **Composites:** Fundamentals of composites and structures, need for composites, classification of composites, classical lamination theory, Matrix materials, Reinforcement materials, applications of various types of composites, Fibre production techniques for glass, carbon and ceramic fibre.

Unit II:
> **Metal Matrix Composites:** Characteristics of MMC, limitations of MMC, rule of mixtures, processing of MMC, powder metallurgy processes, Diffusion bonding, Stir

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Casting, Squeeze casting, In-situ reactions, Interface, measurement of interface properties, applications of MMC in aerospace, automotive industries.

Unit III:

Ceramic Matrix Composite & special composites: Need for Ceramic Matrix Composites, Toughening Mechanism, Processing, Sintering, Hot pressing, Cold Isostatic Pressing (CIP), Hot Isostatic Pressing (HIP), applications of CMC in aerospace and automotive industries, Carbon composites, advantages of carbon matrix, limitations of carbon matrix and carbon fibre, chemical vapour deposition of carbon on carbon fibre perform, sol-gel technique.

Unit IV:

Interface & Failure analysis: Interphase, mechanisms of bonding, measurements of interface bonding strength, yielding, particle/fibre fracture, Interface de-cohesion/de-bonding, elastic stress analysis of composite material, fatigue strength improvement techniques, stress concentration around cut outs in composite laminates, stability of composite laminate plates and shells, Hybrid materials, applications.

D. Teaching/Learning/Practice Pattern:

Teaching: 70 %
Learning: 30 %
Practice: 0 %

(Teacher is to divide components for T/R/P)

E. Examination Pattern:

1. Theoretical Examination

F. Reading List:

Books:
1. *D. Hull & T. W. Clyne, An Introduction to Composite Materials, Cambridge Solid State Science Series.*
2. *K. K. Chawla, Composite Material: Science and Engineering, 2nd Edition, Springer, 1998.*
3. *T. W. Clyne & P. J. Withers, An Introduction to Metal Matrix Composites, Cambridge University Press, 1993.*
4. *R. M. Jones, Mechanics of Composite Materials, Taylor and Francis.*
5. *S. W. Tsai, Mechanics of Composite Materials,2nd edition, MGH.*
6. *A. K. Kaw, Mechanics of Composite Materials, 2nd edition, CRC Press.*
7. *A. R. Bunsell and J. Renard, Fundamentals of Fibre Reinforced Composite Materials.*

Magazine:
1. *Polymer Composites, Macro- and Micro composites.*

Journals:
1. *Composite Structure, Elsevier.*
2. *Ceramic International, Elsevier.*
3. *Procedia Engineering, Elsevier.*
4. *Journal of Alloys And Compounds, Elsevier.*
5. *Journal of Composite Materials.*

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6. *Journal of Tribology.*
7. *Journal of Applied Mechanics.*
8. *Journal of Materials Science.*

Name of the Module: Turbomachines
Module Code: ME 704/2
Semester: 7th
Credit Value: 3[P=0, T=0, L=3]
Module Leader:

A. Objectives:

The course is design to meet with the following objectives:

1. Provide a thorough understanding of the principles and applications of turbomachinery in modern industry.
2. Analyze a useful tool for designing and researching on turbomachinery instruments.

B. Learning Outcome:

Upon completion of the subject, students will be able to:

1. Understand the concept of fluid mechanics and thermodynamics in turbomachinery.
2. Describe the basic characteristics of radial and axial pumps, compressors, turbines and fans with different kinds of working mediums.
3. Determine performance of compressor and turbine.
4. Analyse the fluid mechanics responsible for limits of turbomachinery operability and stability, particularly, stall, surge, cavitations, and choke.

C. Subject Matter:

Unit I:

   Introduction : Dimensional analysis & similitude, Performance laws, incompressible flow analysis, performance characteristics, variable geometry turbo machines (axial, radial & mixed flow machines), specific speed & cavitation, compressible gas flow relations and compressible fluid analysis, inherent unsteadiness of flow within turbomachines.

Unit II:

   Two dimensional Cascades : Cascade nomenclature & geometry, Analysis of cascade forces, energy losses, lift & drag, circulation and lift, efficiency of compressor cascades, performance of two-dimensional cascades, cascade wind tunnel & instrumentation, cascade test results, compressor cascade correlations, turbine cascade correlation, comparison of profile loss in a cascade and in a turbine stage, optimum space-chord ratio.

Unit III:

   Axial flow turbines: Two dimensional theory, Velocity diagrams, stage losses and efficiency, stage reaction, diffusion within blade rows, design point efficiency, max, total-to-static efficiency of a reversible turbine stage.

   Axial flow compressors and fans: 2-D analysis, velocity diagram & thermodynamics of compressor stage, stage losses & efficiency, reaction ratio & stage loading, Off-design performance, stage

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pressure rise, pressure ratio in a multistage compressor, estimation of compressor stage efficiency, Axial flow ducted fans, Blade element theory.

Unit IV:

Radial Flow Turbine: Losses & efficiencies, work & power calculations, velocity triangles & thermal design, Types of inward flow radial turbines, thermodynamics of IFR turbines, rotor design, nominal design point efficiency, loss coefficients, incidence losses, clearance & windage losses, significance & application of specific speed.

Centrifugal pumps, fans & compressors: Some definitions, theoretical analysis, Inlet casing and impeller, conservation of rothalpy, diffuser, limitation of inlet velocity, optimum design of pump & compressor inlet, slip factor, performance characteristics, choking in a compressor stage.

D. Teaching/Learning/Practice Pattern:

Teaching: 70 %

Learning: 30 %

Practice: 0 %

(Teacher is to divide components for T/R/P)

E. Examination Pattern:

1. Theoretical Examination

F. Reading List:
Books:
1. *S. L. Dixon, Fluid Mechanics and Thermodynamics of Turbomachinery, 5th edition ,Elsevier.*
2. *Cherkasky, Pumps, fans and compressors.*
3. *S. M. Yahya and Satya Prakashan, Turbines, fans and compressors.*
4. *W.J. Kearton, Steam Turbine theory and Practice.*
5. *R. Yadav, Steam & Gas turbines, Central Publishing House.*
6. *V. Ganesan, Gas Turbines, TMGH.*
7. *G. F. Round, Incompressible Flow Turbomachines: Design, Selection, Applications, and Theory.*
8. *H. Cohen, G. F. C. Rogers and H. I. H. Saravanamuttoo, "Gas Turbine Theory",6th rev edition Pearson.*

Magazine:
1. *Microturbines: Applications for Distributed Energy Systems by Claire Soares.*

Journals:
1. *Journal of Mechanical Engineering, Editorial Office of Chinese Journal of Mechanical Engineering.*
2. *The Reduction of Over Tip Leakage Loss In Unshrouded Axial Turbines Using Winglets And Squealers, Zbigniew Schabowski And Howard Hodson.*
3. *A Global Approach to Turbomachinery Flow Control: Passage Vortex Control, Matthew J. Bloxham And Jeffrey P. Bons.*

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Name of the Module: Computer Aided Design and Graphics

Module Code: ME 704/3

Semester: 7th

Credit Value: 3[P=0, T=0, L=3]

Module Leader:

A. Objectives:

The course is design to meet with the following objectives:

1. Explain how computer technology is revolutionizing drafting, design, and engineering.
2. Describe the basic features and operation of a computer-aided drafting program.
3. Explain the various commands used to create objects in CAD.
4. Describe the tools used to modify CAD drawings.
5. Identify the various display functions used in CAD programs.
6. Describe the typical components in a CAD program Help system.
7. Explain the importance of CAD file management and identify common storage techniques.
8. List different types of CAD software and their applications.

B. Learning Outcome:

Upon completion of the subject, students will be able to:

1. Understand basics of computer aided design with graphics and transformations
2. Derive and solve finite element problems consisting of one-dimensional structural elements.
3. Develop skills for geometric modeling for engineering design
4. Utilize computerized tools for solving problems

C. Subject Matter:

Unit I:

   Computer Technology: Introduction, CPU, memory, input, output, data representation, programming languages (Machine/ assembly/HLL).

Unit II:

   Design Process: General design process, computer application for design and introduction of FEM (1-D elastic problems, pre and post processing.

Unit III:

   Geometrical Modeling: Defining the model, technique for geometrical modeling (wire frame/ surface/solid), entity manipulation and data storage, Standards for CAD, elements of interactive computer graphics (ICG), Applying CAD model in design.

Unit IV:

   Drawing Algorithms, Transformations: Line and circle drawing algorithm, transformation (2D and 3D), character generator, windowing & clipping, Splines and Bazier curves.

   Expanding the capability of CAD: Introduction, A.I in design (expert/knowledge based system), Parametric and variation modeling, feature based modeling, design information systems.

D. Teaching/Learning/Practice Pattern:

   Teaching: 70 %

   Learning: 30 %

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Practice: 0 %

(Teacher is to divide components for T/R/P)

E. Examination Pattern:

1. Theoretical Examination

F. Reading List:

Books:

1. *C. McMahon and J. Browne, CAD/CAM: Principle, Practice and Manufacturing Addision Wesley Publishers, London.*
2. *Ibrahim Zied, Computer Aided Design, MGH.*
3. *Groover & Zimmers,Jr, CAD/CAM (Computer Aided Design and Manufacturing),1ˢᵗ edition, PHI.*
4. *Hern and Baker, Computer graphics,2ⁿᵈ edition, PHI.*

Magazine:

1. *Computer-Aided Intelligent Recognition Techniques and Applications edited by Dr. Muhammad Sarfraz.*
2. *Formal Methods in Computer-Aided Design: 5th International ..., Volume 5 edited by Alan J. Hu, Andrew K. Martin.*

Journals:

1. *Journal of Mechanical Engineering, Editorial Office of Chinese Journal of Mechanical Engineering.*
2. *Cad Computer Aided Design, Elsevier Ltd*
3. *Computer Aided Geometric Design. Elsevier.*

Name of the Module: Finite Element Methods
Module Code: ME 704/4
Semester: 7th
Credit Value: 3[P=0, T=0, L=3]
Module Leader:

A. Objectives:

The course is design to meet with the following objectives:

1. To teach students the finite element method
2. To convey the basic ideas on which the method is founded.
3. The basic principles of the method with applications in several areas
4. To apply the method to problems of their individual interests. A multi-physics finite element code, ANSYS is used for applications.

B. Learning Outcome:

Upon completion of the subject, students will be able to:

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1. Have mathematical foundation of FEM techniques
2. Derive the finite element equations for different boundary- and initial-boundary-value problems.
3. Use partial-differential equation concepts, variational principles, and interpolation theories to derive finite element model.
4. Develop finite element algorithms for steady and transient problems.
5. Analyze and evaluate the solution using finite element codes. Make error analysis and checks to verify accuracy of the finite element solutions.

C. Subject Matter:

Unit I:

Introduction: Fundamental concepts of finite element methods, direct equilibrium method, work or energy method, method of weighted residuals, variational principles, interpolation and shape function, general formulae for element matrices, nodal loads produced by traction and body force.

Unit II:

One dimensional finite element analysis : linear spring/ plane stress/ space truss (axial displacement) , 1 D torsion (torsional rotation), 1 D heat conduction (temperature), 1 D seepage (fluid potential), FE based on displacement field.

Two - Dimensional finite element analysis (using CST): 2- D stress analysis, 2-D confined seepage analysis, applications of 3-D equations for 2-D analysis (Axi-symmetric situation).

Two-dimensional iso-parametric elements and numerical integration: introduction, four node, quadrilaterals, higher order elements.

Beams: Formulation, load vector, boundary considerations, shear force and bending moment.

Unit III:

Computer implementation of FEM: use of symmetry and anti-symmetry conditions in reducing a problems, static condensations, storage scheme for global stiffness matrix, application of boundary condition.

D. Teaching/Learning/Practice Pattern:

Teaching: 70 %

Learning: 30 %

Practice: 0 %

(Teacher is to divide components for T/R/P)

E. Examination Pattern:

1. Theoretical Examination

F. Reading List:

Books:

1. *T. R. Chandrupatla and A. D. Belegundu, "Introduction to Finite Element Engineering", PHI.*
2. *J. N. Reddy, "An Introduction to the Finite Element Method",3rd revise edition, MGH.*
3. *K. J. Bathe, "Finite Element Procedures in Engineering Analysis", Prentice-Hall.*
4. *K. J.Bathe, "Finite elements procedures",1st edition, PHI.*
5. *O. C. Eienkiewicg and K. Morgan, "Finite Elements Approximations",1st edition, MGH.*

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6. *Baker, "Finite Element Method in Fluid Mechanics", MGH.*
7. *S. S. Rao, "The Finite Element Method in Engineering".4th edition*
8. *John E. Dolbow and Tod A. Laurse, " Finite Elements in Analysis and Design".*

Journals:

1. *Journal of Mechanical Engineering, Editorial Office of Chinese Journal of Mechanical Engineering.*
2. *Finite Elements in Analysis and Design, Elsevier.*
3. *Finite Fields and Their Applications, Academic Press Inc.*

Name of the Module: Non Conventional Energy

Module Code: ME 704/5

Semester: 7th

Credit Value: 3[P=0, T=0, L=3]

Module Leader:

A. Objectives:

The course is design to meet with the following objectives:

1. To impart the knowledge of need and role of Non-Conventional Energy sources particularly when the conventional sources are scarce in nature.
2. To study the fundamental principles of the various non conventional energy options and their applications.

B. Learning Outcome:

Upon completion of the subject, students will be able to:

1. Understand the different non conventional energy sources.
2. Evaluate the applications of non conventional energy resources including their storages and applications.
3. Select preliminary design of various energy systems.
4. Recognize the need and ability to engage in lifelong learning for further developments in this field.

C. Subject Matter:

Unit I:

   Non-conventional Energy sources: General introduction to non-conventional energy source and systems.

   Solar radiation: measurement, collection, storage, and applications.

   Solar Energy: Solar system, Design of solar energy operated systems, Photovoltaic devices.

Unit II:

   Wind energy: Potential evaluation.

   Types of wind machines: Horizontal and vertical axis wind rotors performance,   Generating systems, applications.

Unit III:

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Design and evaluation of wind mills: Wind regime analysis.

Bio-mass: Recycling of agricultural wastes, Conversion technologies, types, Digester.

Unit IV:

Other Technologies: MHD, Thermoelectric, Thermionic, thermo nuclear fusion technology.

D. Teaching/Learning/Practice Pattern:

Teaching: 70 %

Learning: 30 %

Practice: 0 %

(Teacher is to divide components for T/R/P)

E. Examination Pattern:

1. Theoretical Examination

F. Reading List:

Books:

1. Black & Vealch, "Power Plant Engineering",1st edition , MGH.
2. G. D. Rai, "Non- conventional energy source", Khanna Publishers.
3. J. Parikh, "Energy models: 2000 and Beyond", TMGH.
4. B. Ghosh , S. K. Saha and S. Basu, "Towards clean energy", TMGH.
5. Kreith and Kreider, "Principles of solar engineering", 2nd edition ,Hemisphere.
6. P. K. Nag, "Power Plant Engineering",3rd edition , TMGH.

Magazine:

1. Non- Conventional Energy Resources.
2. Limitations of Conventional Sources of Energy.

Journals:

1. Journal of Mechanical Engineering, Editorial Office of Chinese Journal of Mechanical Engineering.
2. Development of Non-Conventional Energy Sources, Indian Institute of Technology, India Moradabad Institute of Technology, India.
3. Solution for De-loading the Grid by Non-Conventional Energy Resources, International Journal of Applied Engineering Research.
4. Nuclear Energy as "Non-Conventional Source of Energy", Excel Journal of Engineering Technology and Management Science.

Name of the Module: Principles of Tribology
Module Code: ME 704/6
Semester: 7th

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Credit Value: 3[P=0, T=0, L=3]

Module Leader:

A. Objectives:

The course is design to meet with the following objectives:

1. To provide the students with the fundamental concepts and principles of tribology.
2. Emphasis on the design, selection and performance of lubricated components such as pistons, bearings, gears etc.
3. To understand the concepts of friction and wear and to deal with surface properties, contact mechanics in the field of Industrial Tribology.

B. Learning Outcome:

Upon completion of the subject, students will be able to:

1. Understand basic principles of tribology.
2. Apply the theories of friction, wear and lubrication to predict frictional behaviour of commonly encountered sliding interfaces.
3. Differentiate the features of rough surface and liquid lubricants.
4. Anticipate the latest research on new topics in tribology including its application to nanoscale devices and biological systems.

C. Subject Matter

Unit I:

   Friction: Introduction, Modes of friction, dry friction.

Unit II:

   Lubrication: Boundary lubrication, hydrodynamics and hydrostatic lubrication, Elastic hydrodynamics lubrication, design characteristics of slider bearings.

Unit III:

   Bearings: Operating characteristics of slider bearings, wears types and characteristics, Selection of rolling elements bearing and their operating parameters.

Unit IV:

   Industrial lubricants: Oils, Grease, solids and special lubricants, bearing failures, bearing maintenance, diagnostic maintenance of tribology components.

D. Teaching/Learning/Practice Pattern:

   Teaching: 70 %

   Learning: 30 %

   Practice: 0 %

(Teacher is to divide components for T/R/P)

E. Examination Pattern:

   1. Theoretical Examination

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F. Reading List:

Books:

1. *B. C. Majumdar, "Introduction to Tribology of Bearings", A. H. Wheeler & Co. Ltd., New Delhi.*
2. *O. Pinkus and B. Sternicht, "Theory of hydrodynamic lubrication", MGH.*
3. *A. Cameron and C. M. Mc Ettles, "Basic Lubrication Theory", Wiley Eastern Ltd., New Delhi.*

Magazine:

1. *Tribology & Lubrication Technology, Society of Tribologists and Lubrication Engineers.*
2. *Machinery lubrication, Noria Corporation.*

Journals:

1. *Journal of Mechanical Engineering, Editorial Office of Chinese Journal of Mechanical Engineering.*
2. *Tribologia, Helsinki University of Technology.*
3. *Tribology - Materials Surfaces and Interfaces, Maney Publishing.*
4. *Tribology Letters, Springer New York.*

Name of the Module: Theory of Elasticity

Module Code: ME 704/7

Semester: 7th

Credit Value: 3[P=0, T=0, L=3]

Module Leader:

A. Objectives:

The course is design to meet with the following objectives:

1. To make students understand the principles of elasticity.
2. To familiarize students with basic equations of elasticity.
3. To expose students to two and three dimensional problems in Cartesian and polar coordinates.
4. To make students understand the strain-energy methods.

To introduce to students the method of calculation of stresses in components of circular and

noncircular cross section subjected to unsymmetrical bending and torsional loading.

B. Learning Outcome:

Upon completion of the subject, students will be able to:

1. Understand 3D stress and strain components.
2. Utilize energy methods for solving the problems of theory of elasticity.
3. Solve the unsymmetrical straight and curved beam problem.
4. Examine the thick and thin walled cylinder problems.
5. Model the structural column problems.

C. Subject Matter:

Unit I:

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Department of Mechanical Engineering

Introduction: Elasticity, stress, components of stresses, components of strains, generalised law. Plane Stress and Plane   Strain: plane stress and plane strain, stress at a point, strain at a point, differential equation of equilibrium, boundary condition stress function. 2D Problems in Rectangular Co- ordinates

Unit II:

Solution by polynomial, stvenant's principle, determination of displacement, bending of cantilevers loaded at the ends, bending of beams by uniform loads etc.

Unit III:

2D Problems in Polar Co-ordinates: general equation in polar co-ordinates, stress distribution, symmetrical about an axis. Pure bending of curve bars, strain components in polar coordinates, Displacement for symmetrical stress distribution, rotating disks, bending of a curved bar by a force at the end.

Unit IV:

Photoelasticity: Experimental method and verification, circular polariscope, photo elastic stress-distribution, determination of principle stresses, 3-dimensional photoelasticity.

D. Teaching/Learning/Practice Pattern:

Teaching: 70 %
Learning: 30 %
Practice: 0 %

(Teacher is to divide components for T/R/P)

E. Examination Pattern:

1. Theoretical Examination

F. Reading List:
Books:
1. *Timoshenko and Goodier, "Theory of elasticity", MGH.*
2. *Dally and Riley, "Experimental Stress Analysis", MGH.*

Magazine:
1. *Popular Mechanics.*
2. *Everyday Engineering Magazine.*

Journals:
1. *Journal of Mechanical Engineering, Editorial Office of Chinese Journal of Mechanical Engineering.*
2. *International Journal of Plasticity, Elsevier Ltd.*
3. *Journal of Elasticity, Springer Link.*

Name of the Module: Boundary Layer Theory
Module Code: ME 704/8

NATIONAL INSTITUTE OF TECHNOLOGY

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

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Department of Mechanical Engineering

Semester: 7th

Credit Value: 3[P=0, T=0, L=3]

Module Leader:

A. Objectives:

The course is design to meet with the following objectives:

1. An understanding of fluid mechanics fundamentals, including concepts of mass and momentum conservation.
2. Knowledge of laminar and turbulent boundary layer fundamentals.
3. An exposure to recent developments in fluid mechanics, with application to aerospace systems.

B. Learning Outcome:

Upon completion of the subject, students will have the:

1. Understand the basic principle of fluid mechanics.
2. Apply the Navier Stokes equation with boundary condition for different geometries
3. Solve boundary layer equations using different methods of solution
4. Analyse the boundary layer phenomenon for different flow situations.

C. Subject Matter:

Unit I:

   Outline of fluid motion with friction: real and perfect fluids, viscosity and compressibility, similarity principles, comparison between theoretical experimental and numerical study of flow, Concept of boundary layer, boundary layer separation and vortex formation.

Unit II:

   Navier Stokes equation: fundamental equation of motion and continuity applied to fluid flows, Stokes hypothesis and N-S equation, Simplification of N-S equation, Normalisation of N-S equation, Order of magnitude and simplification of N-S equation, Prandtl**e**'s Boundary layer Theory & Boundary layer equation.

Unit III:

   Laminar boundary layer: boundary layer equation for 2 –D incompressible flow, separation & control of boundary layer, momentum integral equation for boundary layer, Some exact solutions steady state boundary layer equation-flow past a wedge, flow in a convergent channel, and flow past a cylinder.

Unit IV:

   Approximate methods: solution for flow over flat plate at zero incidences, flow past a circular cylinder, fundamentals of turbulent boundary layer, Reynolds equation, Prandtles mixing length, Introduction to thermal boundary layer, heat conduction equation from boundary layer equation, general properties of thermal boundary layers, force and natural flows, adiabatic walls.

D. Teaching/Learning/Practice Pattern:

   Teaching: 70 %

   Learning: 30 %

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Practice: 0 %

(Teacher is to divide components for T/R/P)

E. Examination Pattern:

1. Theoretical Examination

F. Reading List:

Books:
1. *F. M. White, "Viscous Fluid Flow", 3rd edition ,MGH.*
2. *Duncun, Thom & Young, "Mechanics of fluid", Arnold Publications.*
3. *B. S. Massey, "Mechanics of fluid".*
4. *H. Schlichting, "Boundary layer theory", 8th edition ,MGH.*

Magazine:
1. *Pumps & Systems.*
2. *World Pumps.*
3. *Hydraulics & Pneumatics.*

Journals:
1. *Journal of Mechanical Engineering, Editorial Office of Chinese Journal of Mechanical Engineering.*
2. *Boundary-Layer Meteorology, Springer Netherlands.*
3. *Considerations Regarding the Mathematical Basis for Prandtl's Boundary Layer Theory, Paul C. Fife.*
4. *Higher-Order Boundary-Layer Theory, M Dyke.*

Name of the Module: Non-Traditional Manufacturing
Module Code: ME 704/9
Semester: 7th
Credit Value: 5[P=0, T=0, L=3]
Module Leader:

A. Objectives:
The course is design to meet with the following objectives:
1. Differentiate between conventional and non traditional machining.
2. Classify different non traditional machining processes including their need.
3. Describe the basic mechanism of material removal in non traditional machining (AJM, WJM, EDM, ECM and USM).
4. Identify the process parameters and machining characteristics of non traditional machine.
5. Analyse the effect of process parameters on material removal rate (MRR).

B. Learning Outcome:
Upon completion of the subject, students will be able to:
1. Have a clear idea of difference between conventional machining and non traditional machining.

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2. Know different non traditional machining processes.
3. Know the working principle of non traditional machine equipment.
4. Mechanism of material removal in non traditional machining (AJM, WJM, EDM, ECM, USM).

C. Subject Matter:
Unit I:

New technologies: AJM, WJM, EDM, ECM, USM: working principle, components of set up, field of application, Parameters affecting machining characteristics, Material removal mechanism.

Unit II:

Nano-machining: processing systems of nano-metric accuracies and sub-nanometric processing Resolutions, processing unit, breaking stress and processing energy densities, Mechanism of materials processing based on imperfections or defects in materials.

Unit III:

Nano-mechanical processing of atom clusters and sub-crystal grain units, Nano positioning system applications of nano-technology, Energy beam processing of materials.

D. Teaching/Learning/Practice Pattern:

Teaching: 60 %
Learning: 40 %
Practice: 0 %

(Teacher is to divide components for T/R/P)

E. Examination Pattern:
1. Theoretical Examination.

F. Reading List:
Books:
1. *Pandey & Shah, "Modern Machining processes", TMGH.*
2. *Bhattacharya, "New Technology", Institution of Engineers Pub. (Calcutta).*
3. *P. K. Misra, "Non- conventional machining", Narosa Publishers.*

Magazine:
1. *Manufacturing Maker Spaces.*
2. *3D-Printing and the Future Manufacturing.*

Journals:
1. *International Journal of Machining and Machinability of Materials, ISP.*
2. *Journal of Manufacturing Science and Engineering.*
3. *International Journal of Machine Tools and Manufacture, Elsevier.*
4. *Journal of Materials Processing Technology. , Elsevier.*